The Engineering News.

A Journal of Practical Science and Public Improvements.

PUBLISHED MONTHLY

AT 168 WASHINGTON STREET, CHICAGO, ILLINOIS.

GEO. H. FROST, Editor and Proprietor.

NOVEMBER 15th, 1875.

LIVERPOOL WATER SUPPLY.

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There are cases, however, where the necessity for this intermittent system is the result, not of a lack of a sufficient supply for all ordinary uses, but of the enormous waste which prevails, more or less, in every city having a public water supply by means of the usual appliances of underground pipes and conduits. In the city of Chicago which draws its supply of water from that inexhaustible reservoir, Lake Michigan, so extravagant are the people in the use, and so willful in the waste, of the precious fluid during the entire year, but especially in the summer season, that in the remote districts of the city, the water almost entirely ceases to run at some hours of the day, and even in the very heart of the city, the water is with difficulty forced to the third stories of the houses, and hardly ever beyond. In hundreds of houses during the warm season, the water is kept running to cool the air, and from thousands of garden hose pipes it is left to run both day and night, while from many of the private hydrants which are everywhere present in the yards of the poorer classes of people, streams are constantly flowing at full pressure, either or the amusement of crowds of urchins, or through willful neglect of turning it off by the occupants of the premises. In winter, the water runs from hydrants, both public and private, and from the pipes in almost all the houses and factories, to prevent it from freezing and so causing damage by the bursting of the pipes. The Board of Public Works has remonstrated with, and threatened, and the newspapers have lectured, the inhabitants about the matter time and again, but with little or no beneficial effect, and the only remedy that seems to be of any avail is to add more force at the pumping works until there is no lack anywhere within the limits of the water supplied districts, which remedy is being applied now in the construction of the new tunnel and pumping works in the South Division of the city.

But the principal purpose of this article is to show the evils of the intermittent system of supply, and of the waste of water, together with the means adopted for diminishing the latter, and so hastening the restoration of a constant service.

In a paper read before the Institution of Civil Engineers, by Geo. F. Deacon, M. Inst. C. E., and Borough Engineer of the City of Liverpool, entitled "On the Systems of Constant and Intermittent Water Supply, and the Prevention of Waste, with special reference to the restoration of Constant Service in Liverpool," we have perhaps the best treatment of the subjects under consideration yet published anywhere. Mr. Deacon has for many years filled his present responsible position, and has paid special attention to the water supply of the great city of Liverpool and his paper is a most valuable contribution to the literature of Engineering. We would like to publish it entire, together with the plates illustrative of it, for the benefit of the readers of ENGINEERING NEWS, but the great length of the paper, and our limited space, prevents us making more than an abstract of it.

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Unexceptionable house drainage, however seldom realized, is generally regarded as indispensable; but the necessity for preventing waste of water is far less obvious. The consumer recognises in such prevention no direct sanitary benefit, and so takes little pains that the water fittings shall be of the best possible construction, and the pipes of the required strength; and although on the part of those who supply the water, great alarm is often manifested, the conditions required to prevent leakage, even when no substantial impediment to its prevention exists, are often entirely disregarded. It might be supposed that water companies would be so influenced by the risk of increased future expenditure, that they at least would resort to all practicable means for the prevention of waste; but, at the present time, many of those companies are allowing water to be laid on at high pressure for the supply of service pipes and fittings such as must inevitably, in the course of a few years, lead to great and continuous waste; and if this obtains under the control of bodies whose pecuniary interests are so intimately affected, it is easy to understand that the laxity in the case of many water committees of corporations and local boards is equally great.

When conditions such as these prevail, it is not strange that the state of pre-existing fittings and pipes is almost wholly neglected. There are but few towns, except those in which a water supply has only recently been introduced into the houses, which do not present the most incongruous combination of pipes and fittings of every kind in use since, or even before, the abandonment of those hollow trunks of trees which formed some of the earliest water mains, and many miles of which have been recently dug up. Between such antiquated appliances, and the pipes of the great strength and fittings of the comparatively perfect mechanism now known to be necessary to resist the influence of frost, surface traffic, and increased internal pressure, the step is a wide one; even the very existof many pipes is often unknown. It is not surprising therefore that under both roads and houses there are innumerable sources of continuous waste which no ordinary inspection, however careful, can detect. Exhaustive reports have been prepared by engineers; Parliamentary Committees and the Board of Trade have inquired into the subject in the most thorough manner, and in a few towns complete success has attended the endeavors to prevent waste; but all this has done little to relieve the feeling of comparative helplessness which so generally prevails.

Under these circumstances the Author submits the followfng remarks on the subject generally, together with the results of his experience in the matter, gained n connection, not indeed with the metropolis, but with a town of the first importance, the water supply of which, having been changed from constant to intermittent service, has been regarded as a most unfortunate example of the evils resulting from waste of water.

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This being the mode of disposition of the water under constant service, it is obvious that, if the duration of supply to the main in question were reduced to twelve hours a day, half the water hitherto wasted, or in this instance 35 gallons out of every 100, would be saved, less the waste from fittings connected with cisterns, which would continue until the storage was exhausted. But this would not be a correct measure of the gross reduction in the volume of water taken, as experience shows that the consumers would, while the water remained on, draw more freely than before, and would generally store as much of it as possible until the supply valve was again opened.

Thus the system of intermittent supply increases to some extent the use, or rather misuse, of water, reducing at the same time the most important element of waste nearly in direct proportion to the reduction in the hours of supply, and as it is the most obvious method by which the loss of water may be limited, the expedient has frequently been resorted to.

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In most towns defects of this nature are probably as numerous and important as in Liverpool, where open ends and large holes in water pipes have been found in direct communication with the sewers and drains, and in such relation to the system of mains and pipes that an indraft of sewer air must inevitably have taken place each day during intermittent service, with which air the water first drawn in the morning must have been charged.

In the poorer districts of many towns water is laid on to closets by pipes direct from the mains. Under intermittent supply the basins cannot, therefore, be flushed out except when the water is on. The more frequent stoppage of the drains follows of necessity, and the pan often remains charged in consequence. The supply pipes are in many instances commanded only by common cocks, which are liable to be left open, and in such cases there must be an indraft from the closet pan each time the water is cut off from the district. These evils, which any person interested in the details of the distribution of water may ascertain, deserve the gravest consideration.

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itary evil, and is, in the Author's judgment, a most fertile element in the production of intemperance. The storage of water in cisterns for drinking and culinary purposes is most objecticnable, much more so than is generally understood. Such cisterns are commonly found in close contiguity to, or even connected by a pipe with, the drainage system of the house. They are often uncovered, and so become the receptacles for decaying animal matter; frequently, too, they are exposed to the direct rays of the sun and become polluted with organic growth, while when containing water from some sources, they are often the cause of lead poisoning. The Author has in numerous instances found the overflow pipes from covered cisterns for storing drinking water actually connected with the soil pipes below the traps, so that the surface of the water was in direct contact with air from the house drains and sewers.

Under the intermittent system water for drinking is necessarily subject more or less to these conditions: under the constant system it may be drawn direct from the main, and the cistern may be retained for other purposes. But, apart from all considerations of the intermittent service which it so often induces, the waste of water is harmful in itself; although some influential men advocate a supply of water so abundant that it may be wasted to an unlimited extent, on the plea that it flushes the sewers and teaches people to be cleanly. But these impressions are not borne out by the facts. Of all the water wasted a large portion does not find its way direct to the drains. Throughout the older parts of Liverpool, for example, even during a dry summer season, and although the basement of every house had been drained, the cellars and the soil around were in most cases completely saturated with water from the town supply. This was their state under intermittent service, and if constant service had been a possibility without a reduction of waste, its blessings would have been greatly alloyed by the augmentation of a condition which could not fail to exercise a prejudicial influence on the comfort and health of the people.

In isolated instances, and for a short space of time, some individual drain may be benefited by an excess of water; but by the larger portion of the waste, viz., that which finds its way through the ground, and thence through the brickwork, injury is done to the structural condition of the sewers, and to their effective action.

The most enthusiastic advocate of superabundant supplies would scarcely suggest that a larger quantity than 100 gallons per head per day should be given; but assume that 100 gallons per head per day, in excess of the water used, flow continuously down a single house drain. Suppose there are ten inmates, a number far above the average for each house, there will be warted in twenty-four hours, 1000 gallons, a quantity which could not have the smallest beneficial influence upon any drain. It would be a mere driblet, such as would pass from a pipe under ordinary pressures, through a hole the size of a pin's head.

The main sewers and outfalls in the lower parts of towns, where the quantity of water is usually too great, receive the aggregated driblets, and moreover, as in those parts the pressure in the mains is greatest, they receive the larger portion direct, and not after passing through the branch sewers above, to which they might in isolated cases be of some benefit.

Happily the cleanliness of branch sewers and drains is not dependent upon the waste of water. It is the result of experience that the sudden discharge of two gallons of water through a soil drain each time that drain is made use of is thoroughly effective in cleaning it, and this sudden flush is provided for by all properly drawn up regulations as to water fittings. Further, at the heads of all branch sewers in towns flushing chambers for intermittent action may be constructed which will give a perfectly satisfactory result with an expenditure of water no greater than one quart per head per day.

[TO BE CONTINUED.]

A large amount of correspondence has been received which will appear in our next issue.

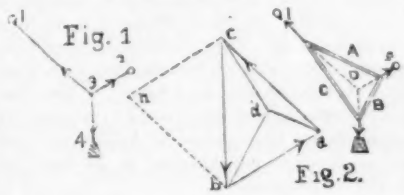
The North Chicago Rolling Mill Company expects to make 8000 tons of iron and steel rails this month.

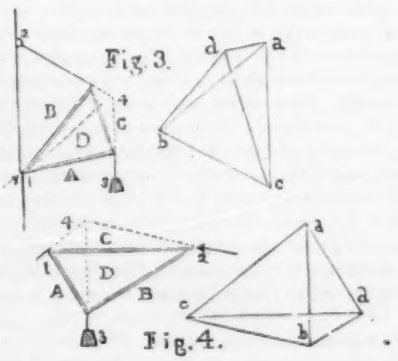
GRAPHICAL ANALYSIS OF ROOF TRUSSES.

BY CHAS. E. GREENE, A. M., PROF. OF CIVIL ENGINEERING, UNIVERSITY OF MICHIGAN.

I

It is proposed in this series of articles, to explain and illustrate a method for finding the stresses in all the pieces of a roof or other truss, under the action of a steady load, and to show how the wind or any oblique force alters the amount of the stresses arising from the weight. The diagrams, as here developed, are credited in England to Prof. Clerk-Maxwell, and the method is known by his name. But little previous knowledge of Mechanics will be required of the reader to understand the explanations, and we shall endeavor to make all points clear as we proceed.





Taking it for granted that, if two forces, acting at a common point, are represented by the two adjacent sides of a parallellogram, *ca* and *cw*, Fig. 2, their resultant will be equal to the diagonal *cb* of the figure, drawn from the same point,—a force equal to this resultant, and in the opposite direction, will balance the first two forces. Thence, considering one half of the parallellogram, we have the well-known proposition that, if three forces act at a single point and are balanced, and a triangle be drawn with sides parallel to the three forces, these sides will be proportional in length, by a definite scale, to these forces. The forces will also be found to act in order round the triangle. If the magnitune of one force is known, the other two can be thus readily determined.

For example:— Let a known weight be suspended from the points 1 and 2, (Fig. 1,) by the cords 1-3, 3-2, and 3-4. Draw *cb*, to a convenient scale, vertically, to represent the weight, by so many pounds to the inch. This line will, of course, be parallel to, and will equal the tension on 3-4. Draw *ca*, parallel to 1-3, and *ba* parallel to 3-2. Then will the triangle *cba* represent the forces which act on the point 3, and they will be found to follow one another round the triangle, as shown by the arrows.

Suppose next, that a rigid, triangular frame is fastened on the cords of Fig. 1, so that, as shown by Fig. 2, the cords are attached at the vertices of the triangle, while their directions are undisturbed. Then it matters not if the portions of the cords within the triangle be cut away; equilibrium of this combination as a whole will exist so long as the directions of these cords, or forces external to the frame, meet, if prolonged, at a common point. We desire to find the forces, or stresses, exerted in the three pieces of this frame.

Before proceeding further, let us explain the notation which it is proposed to use, and which will be found very convenient when applied to more complex frames. In Fig. 2, write a letter in every space which is cut off from the rest of the figure by lines along which forces act. Thus D represents the space within the triangle, A the space limited by the external forces on 1 and 2, B the space between the pull on 2 and the line which carries the weight. Then let the piece of the frame or the force which lies between any two letters be called by those letters; thus, the upper bar of the triangle is AD, the right hand bar is BD, the cord to the point 1 is AC, that to the weight is CB, etc. In the triangle of forces external to the frame, *cb* will then be the vertical line of force to correspond with CB, *ba* the tension of the cord BA, and lastly *ac* the pull on 1. This method of notation was introduced by Mr. Bow, in his Economics of Construction.

Consider the left hand apex of the triangle. This point is in equilibrium under the action of three forces, viz., AC, CD, and AD; we know the direction and magnitude of AC, and the direction of the other two. The three forces at this joint must therefore be equal to the three sides of a triangle, as before. Notice that the external forces were taken in the order of the letters ACB, as shown by the arrows on the triangle *acb*. Take then the forces at the left hand angle of the frame in the same order, and commence with the one fully known, or AC. Pass from *a* to *c*, because that is the direction of the action of this force on the joint under consideration. Next, from *c*, draw *cd* parallel to CD, prolonging it until a line from its extremity, *d*, parallel to the piece DA, will strike *a*. The direction in which we passed, from *c* to *d* and then to *a*, shows that CD and DA both pull on the joint where they meet.

Next take the lowest joint, Remembering again to take the three forces in equilibrium at this joint in the same order as the three external forces were taken, and commencing with the first known one, we go, in the stress diagram, from *d* to *c*, because we have just found that the stress on the piece DC is a pull on this joint, next down *cb*, in the direction in which the weight acts, and finally we draw, from *b*, *bd* parallel to the piece BD. This last must close on the point *d*, or the construction has not been carefully made, and the direction in which we draw it, from *b* to *d*, shows that the piece BD exerts tension on the lowest joint. If the reader will run over the triangle for the right hand joint, he will see that the directions just given are complied with.

If we imagine that Fig. 2 is inverted, we shall have three thrusts for the external forces, the stress dia-

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[Entered According to Act of Congress, in the year 1875 by Charles E. Greene, in the office of the Librarian of Congress at Washington.

gram will be inverted, and there will be compression on each piece of the frame.

In order to make these first principles more plain, let us take another case. Suppose a triangular frame, (Fig. 3,) to rest against a wall by one angle, to have a weight suspended from the outer corner, and to be sustained by a cord attached to the third angle and secured to a point 2. Since the frame is at rest under the action of three external forces, and since the known directions of two of these forces, viz., AC and BC, will meet at 4, if prolonged, the thrust of the wall on the frame at 1 must have the direction of the line 1-4, otherwise rotation would take place. These three forces will then be found by the following construction:—draw *ac* vertically, equal to the known weight acting *down* at the right hand corner; next, from *c*, a line parallel to the cord and force CB, and prolong it until, from its extremity *b*, a line may be drawn, parallel to BA, to strike *a*. As we went from *c* to *b*, and then to *a*, CB must pull on, and BA must thrust against, the frame.

To find the stresses on the pieces:—take whichever joint is most convenient, for instance, the one where the weight is attached; pass down *ac* for the external force, and then, observing the order in which the triangle of external forces was drawn, draw *cd* parallel to CD and *da* parallel to DA. CD will be a tie and DA a strut. Take next the joint at 1. Here the reaction, as before ascertained, is *ba*; next, comes *ad*, the thrust of the piece AD against 1; and lastly *db*, parallel to DB, to close on *b*, the point of beginning, shows that DB also thrusts on the joint 1.

Once more, suppose that a triangular frame, (Fig. 4,) has a weight attached to its lowest angle, and that the other two points are supported by two inclined posts. The forces 1-4 and 2-4 must intersect 3-4 at the same point. Draw *ab* vertical and equal to the given weight; draw *bc* parallel to 2-4 and *ca* parallel to 1-4. Note that *bc* and *ca* will both be thrusts. Next draw, for the lowest joint, after passing down *ab* for the weight, *bd* parallel to BD, and *da* parallel to DA, thus finding that BD and DA both pull on the joint AB. As in former cases, find *dc*, which is a compressive stress.

Enough examples have been given to show the first principles of this method. Since, in Mechanics, the polygon of forces follows naturally from the triangle of forces, and is simply a combination of several triangles, then, if we have several external forces or a number of pieces meeting at one joint, we follow the same rules. First, draw the polygon of external forces, taking them in regular succession round the frame, either to the left or right, as may seem convenient; next, take any joint and, commencing with the known force or forces, passing over each line in the direction required by the action of the particular force on the joint under consideration; treat the remaining pieces in the order in which the external forces were taken, and draw lines in the stress diagram parallel to these pieces. The direction in which the lines are drawn gives the action of the pieces on the joint. We dwell on this point at some length, because it must be clearly understood to enable one to rightly interpret his diagram.

Referring now to the figures which have been drawn, Prof. Maxwell calls the frame and the stress diagrams *reciprocal* figures, for the external forces, which must meet at one point (unless parallel,) in the stress diagram, and the pieces which make the triangular frame have their stresses represented by the lines which meet at one point in the stress diagram. This same reciprocity will exist in more complex figures, and it is a valuable check, among many which we have, upon the accuracy of the construction.

Note further, that where the point of intersection of the external forces falls within the triangular frame, the point of intersection of the stresses on that frame, in the stress diagram, fall within the triangle of external forces, and *vice versa*.

In our next paper we shall advance to the treatment of some simple roof trusses.

Astronomical Notes.--No. IX.

PREPARED FOR THE ENGINEERING NEWS BY S. W. BURNHAM, F. R. A. S.

Mr. Bishop's observatory near London, for a long time in charge of Mr. Hind, is to be discontinued, and the instruments presented to the Royal Observatory of Naples. This step has been taken in consequence of the ill health of Mr. Bishop requiring a residence in a milder climate. The astronomical library commenced by Mr. Bishop's father, for many years treasurer of the Royal Astronomical Society, is very complete and valuable, and will probably accompany the instruments. A large amount of double star work has been done with this equatorial in the hands of Mr. Dawes and others.

Another great refracting telescope has been commenced by Grubb, of Dublin, for the new observatory now being erected at Vienna. The object glass is to have a diameter of about 27 inches, and a focal length of 32 feet. The intention seems to be to follow the plan of Clark with the Washington 26-inch refractor, in the use of a steel tube, a hollow base for the driving clock, and in other respects. The revolving dome will be of steel, and made and set up in the first instance, at Dublin. When everything is finished and in working order, the building and instrument will be transported to their destination, The glass is to be manufactured by Feil, of Paris, and the whole is expected to be completed by the autumn of 1878.

The great reflector of the Paris Observatory has been officially visited by the French Minister of Instruction, in company with the distinguished astronomer, Leverrier, and pronounced in every way a complete success. The weight of the moveable part is nine tons. The mirror is 120 centimetres (47,2 in.) in diameter. The weight of the speculum is only half a ton, and it is suspended like the common equatorial refractor. The building covering the instrument can be moved in a few minutes, allowing the telescope to be used in the open air. It is provided with a driving clock and the usual appliances of a complete observatory. Nearly six years have elapsed since the commencement of the work, but it was interrupted by the dismissal of Leverrier, and the war.

At a recent meeting of the French Academy Secchi presented another report of observations of the solar spots and protuberances from April 23d to June 28th of the present year. He records the extent of surface of the spots, instead of the number, as formerly. He finds that the daily number of the protuberances and the surface of the spots have gone on steadily decreasing; that the large eruptions ceased when the large spots disappeared; that the maxima of protuberances at the poles had disappeared, as also the faculæ which had collected round the poles, forming coronæ; and that lofty protuberances were becoming very rare. It appears that we are now near the minimum, and that an increase may be expected shortly. Secchi invites astronomers to carefully note the phases of this increase.

Number 149 of the rapidly increasing list of asteroids was discovered by Perrotin at the Observatory of Toulouse, Sept 21st. He rates it of the thirteenth magnitude. Its place on the 24th was: R. A. 23 hours 18 minutes 36 seconds; Dec. —5° 30′. The latest discovery in this department is by Prof. Watson, of Ann Arbor, who found No. 150 on the night of October 18th. This is given as a tenth magnitude star, and is therefore a more prominent object than most of these miniature planets.

The discovery of a very close and difficult double star (ζ Sagittæ) by Mr. Alvan G. Clarke, was mentioned in the September number of the ENGINEERING NEWS. Since that time the well known observer, Baron Dembowski, of Italy, has succeeded in measuring the position angle on three nights, giving a mean result of 316°.9. The distance, he estimates at not more than 0″.25, making it one of the closest pairs in the heavens. That so difficult an object should have so long escaped notice is not surprising, although repeatedly examined by some of the best observers with much larger instruments.

American Society of Civil Engineers.

Officers elected at 23d Annual Meeting, November 3d, 1875.

Gen. George S. Greene, President.

Gen. Theodore G. Ellis, W. Milnor Roberts, Vice Presidents.

G Leverich, Secretary.

John Bogart, Treasurer.

Octave Chanute, Alexander L. Holley, Francis Collingwood, Gen. Quincy A. Gillmore, Julius W. Adams, Directors.

W. Milnor Roberts, Gen. Quincy A. Gillmore, Francis Collingwood, Finance Committee.

Alexander L. Holley, John Bogart, Gen. Theodore G. Ellis, Library Committee.

INSTRUMENT FOR MEASURING LIGHT.—An instrument by which the rays of light can be measured is the invention of Mr. William Crookes, F. R. S., and is called by him the "Radiometer." It consists of four pith discs, fixed at the extremities of two crossed arms of straws, balanced upon a pivot at the point where the straws cross each other, so that they can spin round on a pivot. The pith discs at the extremities of the four arms are white on one side and covered with lampblack on the other. The whole of this arrangement is enclosed in a glass bulb, from which the air is removed by the aid of the Sprengel air pump. Exposed in daylight every passing cloud makes a difference in the speed at which the arms work. The stronger the light the faster they go. So perfectly can this mechanical force of light be measured, that Mr. Crookes has recorded the rates at which different lights at different distances will drive the discs and arms of the radiometer.

Civil Engineers Club of the Northwest.

CHICAGO, November 16th, 1875.

The next meeting of the Club will be held, Tuesday December 6th, at the Sherman House Club Rooms. The paper prepared by Mr. I. C. Chesbrough for the October meeting, "The Albany Water Works," will be read. Hour of meeting 4:30 P. M.

L. P. MORRHOUSE, Sec'y.

Law and Legislation.

An abstract of decisions of the Supreme Court of the United States and of the courts of the various States in the Union upon questions relating to boundaries, surveys, etc. Compiled for the ENGINEERING NEWS by John Dunn, Esq., Attorney at Law.

316. In determining a boundary line, the original location of the line, if it is shown to have been run and marked, is to be ascertained by tracing in direct lines from one monument to another, whether the distance be greater or less. Melcher v. Merryman, 4 Maine, 601.

317. Where a deed or grant of land is bounded upon a river not navigable, the boundary line extends to the centre of the stream, unless there is a reservation to the contrary. Nichols v. Juncock Manuf'g. Co., 34 N. H., 345.

318. Adverse possession for twenty years of a tract of land upon a river not navigable, gives like to the thread of the stream. Ibid.

319. A party is precluded upon principles of public policy, from setting up or insisting upon a boundary line, in opposition to one which has been steadily adhered to upon both sides for more than forty years. Baldwin v. Brown, 16 N. Y., 359.

320. A long acquiescence in an established boundary line is not merely evidence of an original parol agreement establishing the line, but is ground for a direct legal inference as to the true boundary line, of so controlling a nature that the party is precluded from offering any evidence to the contrary. Ibid.

321. Where A being in possession of lands on both sides of a certain ditch, under claims of title by deed for more than twenty years, made a parol agreement with B, who claimed nine acres of these lands upon one side of the ditch, that the ditch should constitute the division line between them, and B thereupon entered upon the nine acres, and kept possession for five years, it was held, the parol agreement to locate the boundary line, did not of itself affect the true title to the disputed premises, and that A could recover possession. Terry v. Chandler, 16 N. Y., 354.

322. A division fence of more than twenty-one years' standing, although crooked, constitutes the line between adjacent land owners, even though the deeds of both parties call for a straight line between acknowledged land marks. McCoy v. Hance, 28 Tenn. State Rep., 149.

323. Boundaries specified in the original patent, in the absence of intervening descriptions in deeds, by metes and bounds, are presumed to continue. Van Blarcom v. Kip, 2 Dutcher, (N. J.,) 351.

324. In questions of boundary, natural landmarks marked lines and reputed boundaries, especially if known to and acquiesced in by the parties interested, should be preferred, when in opposition to mere magnetic lines, unless there was a known mistake in the marked line. Coles v. Wooding, 2 P. & H. (Va.,) 189.

325. Streets which are well defined and designated by some natural or artificial monument, must govern course and distance in fixing the boundaries of lands; but streets which, in the infancy of a city or town, are only undefined portions of land dedicated to public use, themselves requiring to be located, would furnish very uncertain guides in arriving at the boundaries of other lands. Salsonstall v. Riley, 28 Ala., 164.

326. In determining boundaries under a grant, natural objects as landmarks are to be considered before courses and distances. Daggett v. Wiley, 6 Florida, 482.

327. Where the same party becomes possessed of adjacent estates, the boundary line between which has previously been a subject of dispute, those claiming under him are not estopped from asserting the boundary line to be other than he has uniformly declared it to be. [Ibid.]

328. Hearsay evidence of ancient boundaries is admissible, when the lapse of time is so great as to render it difficult to prove a boundary line by the existence of the primitive landmarks or other evidence than that of hearsay. [Ibid.]

329. Where owners of land adjoining one another agreed upon a boundary line, and a town was laid out by Commissioners on the strength of this agreement, and no objection was made by either to these arrangements for a period of thirty years, it was held, that these were conclusive upon them and that parol evidence of their declarations and admissions was admissible to prove their agreement to and acquiescence in the boundary line. [Ibid.]

330. A survey which starts from certain points and lines, not recognized as boundaries by the parties themselves, and not shown by the evidence to be true points of departure, cannot be made the basis of a judgment establishing a boundary. Martin v. Breaux, 12 La. Ann. 689.

331. Parties are not bound by a consent to boundaries, which have been fixed under an evident error, unless perhaps by the prescription of thirty years. Gray v. Couvillon, 12 La. Ann. 730.

332. To establish a conventional boundary line, different from that apparently indicated by a prior deed, it must appear that both the parties to the convention had a good title, or subsequent parties are not bound. Rogers v. White, 1 Sneed, (Tenn.) 68.

333. Where a deed contains a description of the premises conveyed, by distinct and definite boundaries, accompanied by a general and indefinite description thereof, the former governs. Nutting v. Herbert, 35 N. H., 121.

334. Where a description in a deed does not apply to land intended to be conveyed, but does apply to other land, the description in the deed will prevail, and parol evidence of intention will not be admitted. McAfferty v. Conover, 7 Ohio, (N. S.) 99.

335. Lots adjoining on the east and west were sold by numbers and a plat at the same time to A and B separately. The lines of division were not designated, but the locations were fixed by reference respectively to known and fixed monuments on the east and west. Each deed described the lots as of the width indicated by the plat, more or less. On measurement, the width thus given would not bring the lots together, while the plat showed they were intended to meet, and that the whole was intended to be sold. Held, that the surplus should be divided between A and B in proportion to the lengths of their respective lines shown by the plat, and given in the deeds. Marsh v. Stephenson, 7 Ohio, (N. S.) 264.

336. Where, in a deed conveying land, the description ran: 'Section thirty-five (35) east half, and southwest quarter and east half of northwest quarter of section nine (9)"; it was held that the words "east half" belonged to the foregoing, and not to the following section; and that the deed conveyed only the east half of section thirty-five. Scholk v. Rosiers, 4 Iowa, 328.

City Engineers' Salaries.—1873.

[CONCLUDED.]

Charlestown, Mass.—Before annexation to Boston paid their engineer $1000 per year. Allowed him to do private work but required him to furnish assistants and instruments at his own expense.

Boston, Mass.—City Engineer, $5000. Assistants unlimited in number, and whose pay ranges from $3000 per year, to $1.00 per day. Average about twenty men. City Surveyor, $3600. Assistants unlimited in number and pay. Average about twenty men. City furnishes instruments.

Somerville, Mass.—City Engineer and Surveyor in one, $2000 per year and furnished with assistants. Allowed to do private work.

Milwaukee, Wisconsin.—City Engineer, $2500; Ass't City Engineer, $1900; Draughtsman, $1200; Leveler, $56.66 per month; two chainmen, $2.00 per day.

Nashville, Tenn.—City Engineer, $2500.

Toledo, O.—City Engineer, $2400; assistants from $100 to $125 per month; rodmen from $35 to $55 per month.

Lynn, Mass.—City Engineer, $2000; First Ass't $3.25 per day; Second, $2.00 per day.

Terre Haute, Ind.—City Engineer, $2000; pays his own assistants. Council did allow over $200 for assistance.

Wilmington, Del.—City Engineer, $2000; two assistants at $1000; also has occasional outside assistance.

Dayton, O.—City Engineer, $2000; horse and wagon, $500.

Lawrence, Mass.—City Engineer, $2000; to have all assistance needed.

Little Rock, Ark.—City Engineer, $1800; assistance, $720.

Grand Rapids, Mich.—City Engineer, $1800; assistants, $3.00 a day.

Columbus, O.—City Engineer, $1800; one assistant, $1200; Draughtsman, $1000; two rodmen at $600.

Vicksburg, Miss.—City Engineer, $1800; assistance (1873) $240.

San Antonio, Tex.—City Engineer, $1500; pays assistants and does outside work.

Dubuque, Iowa.—City Engineer, $1500; assistance about $750.

Atchison, Kan.—City Engineer, $1500; assistance, (1873) $600.

Lancaster, Pa.—City Engineer, $1500; assistant, $800; chainmen, $1.50 per day; City Regulator, $3.00 per day when actually employed; two assistants at $1.50 per day.

Evansville, Ind.—City Engineer, $1500; First Assistant, $3.00 per day; Second, $2.00 per day.

Charleston, S. C.—City Engineer, $1500; one rodman, $25 per month.

Augusta, Ga.—City Surveyor, also engineer of Augusta water-works, and also Superintendent of the Turknett Springs water-works, $1500 for all. Allowed to charge $5.00 fee for each city lot surveyed. One assistant "Pump-house keeper," who also acts as chainman, $600. Engineer for Canal Enlargement, $4000; assistant, $1500; Inspector, $4.00 per day; two chainmen at $1.00 per day.

Austin, Texas.—City Engineer, $1200; assistance, $360. Office now abolished. (1874.)

Galveston, Texas.—City Engineer, $1200; city pays for assistance. For establishing monuments or

initial points, at a rate not exceeding that for private surveys. Private work in city, two cents per running foot for any lot, counting from nearest monument, no fee for any one lot to exceed $25.

Syracuse, N. Y.—City Engineer, $1200; one assistant at $2.00 per day. Not allowed to do outside work.

Peoria, Ill.—City Engineer, $1200; allowed assistance when needed, which amounted to $350 in 1873.

Quincy, Ill.—City Engineer, $1200; No allowance for assistance. Fees for grade, $2.00; measuring lots, $3.00 to $5.00; pre and final measurements of excavation or filling from $3 to $10.

Chattanooga, Tenn.—City Engineer, $1000; office and instruments furnished him; employs a rodman at expense of city when needed; no perquisites are allowed.

Atlanta, Ga.—City Engineer, $1000; no assistance allowed. Does private work.

Topeka, Kan.—City Engineer, $900; for assistance during working season, $37.50 per month.

New Albany, Ind.—City Engineer, $900; no allowance paid by the city.

Meadville, Pa.—City Engineer, $900.

Davenport, Iowa.—$400 to $600 per annum according to amount of work.

Ann Arbor, Mich.—$6.00 per day; $2.00 for assistants.

Monroe City, Mich.—$5.00 per day; $3.00 for assistants; both per annum $300.

Rome, N. Y.—1873. $1450.

Saratoga Springs, N. Y.—$400 to $500 per year.

Newport, R. I.—Engineers now employed by the job to survey and make plans; not to exceed $5000.

Newburyport, Mass.—1873, about $500.

Nashua, N. H.—$4.00 per day; $1.50 to $1.75 per day for assistants.

Jacksonville, Ill.—Allows 30 cents per hour for time employed; equals about $600 per year.

Galesburg, Ill.—City Surveyor, $100 per annum. Fees: any lot of land, $2.00; plotting same, 50 cts.; each additional lot, same block, $1.00; grade of street or walk, $1.00 per hour.

Utica, N. Y.—City Surveyor, fees: paving, 2 cents per square yard; sewers, 3½ cents per foot; sidewalks, 1 cent per foot to 500, ½ in excess to 1000, ¼ in excess of 1000; crosswalks, 4 cents per foot; other work, $5.00 per day; $1.50 for assistants when required.

Baltimore, Md.—Salaries for sewer, bridge, highway, &c., departments, $6000. (1873.)

New Haven, Conn.—Special engineering for sewers, (1873,) salaries, $3787.54; City Surveyor, 2000; assistance, $5760.03; surveys for harbor department, $6603.09; road department for surveying and engineering, 1871–2, $13,998.12; do., 1872–3, $9352.64; Engineers, disbursements, 1871–2, 1019.50; 1872–3, $5974.93.

Ypsilanti, Mich.—2.50 for time employed; $300 in 1873.

Ogdensburg, N. Y.—300 to $400 per annum, according to the amount of work.

Keokuk, Iowa.—$5 per day when employed. Allowed to do outside work. Total city engineering amounts to about 200 dollars per annum, Office elective and for one year.

Evansville, Ind.—1500 dollars.

Kansas City, Mo.—2000 dollars, reduced from 2700. Allowed for assistance, 1874 and 75, 1290 dollars.

Portage, Wis.—5 dollars per day for time employed. Assistance allowed by the City.

CORRECTED STATEMENT.

Fitchburg, Mass.—City Engineer, 9.74 dollars per day for time employed. Amount for 1873, 1905.78 dollars. Appropriation for engineering department, 4000 dollars. Total expenses, including assistance, horse hire, drawing materials. etc., 3800.46 dollars.

Correspondence.

CHICO, BUTTE CO., CAL. Oct. 15, 1875.

EDITOR NEWS:—I have always taken a deep interest in the discussions conducted through the medium of the NEWS, and, since a case of a peculiar character came under my observation a few days ago, I herewith give it, trusting that I shall receive new light from your many correspondents.

Section 18 lies between a grant on the east, and the meridian line on the west. The meridian was surveyed in 1853; the exterior lines of the township in 1855; the grant in 1858; and the subdivisional lines in 1867.

The field notes of the subdivisions call for 73.35 chains on the north side of section 18, and 72.40 chains on the south side, while the actual measurement is 67.50 chains on the north side, and 66.21 chains on the south. The subdivision was made by running east on true line, setting quarter section corner at 40 chains, and throwing the fractions on the east side of the section. All traces of the quarter corner are obliterated. Now will the parties entering the fractions on the east side of the section be compelled to lose 48 acres, more or less, or can I subdivive pro rata. Respectfully,

A. L. KNOWLTON,
U. S. Dep. Min. Surveyor.

Ans.—Subdivide pro-rata. [Ed.]

The phrase "By hook or crook" originated in London more than 200 years ago after one of the greatest conflagrations we have any record of, and which swept over that city reducing its greatest portion to ruins and utterly destroying its old landmarks. Many disputes arising concerning the location of the lines between lots, to effect a satisfactory settlement, arbitrators were selected with the customary understanding that their decision should be final. The names of the surveyors in whom this confidence was reposed as the parties affording the most renowned satisfaction, were the Messrs. Hook & Crook, and it was their decisions and their universal approbation, which gained for them so great a notoriety that their boundary lines, so established, became defined as "By Hook & Crook." W. E. P.

Lakeville, Conn.

Mathematical Column.

PROBLEMS.

15. The Selectmen of a certain town appointed a liquor agent and furnished him with liquor to the amount of $825.60, and in cash $215.00. The agent received cash for liquor sold, $1323.40. He paid for liquor bought $937.00; to the Town Treasurer $300; sundry expenses $29.00; his own salary, $265.00. He delivered to indigent persons, by order of the town, liquor to the amount of $13.50. Upon taking stock at the end of the year the liquor on hand amounted to $616.50. Did the town gain or lose by the agency, and how much? Has the agent any money in his hands belonging to the town, or does the town owe the agent? How much? in either case. A. A. P.

16. A weight of 40 pounds, (P,) acts upon a disc weighing 100 pounds, (A,) by a cord wound around it. When no friction is considered, required the velocity of the descending body, (P.) M. T. JR.

17. At what distance on the earth surface should two mountains, three miles and two miles high respectively, be placed, in order that the summit of each should be just visible from the summit of the other.

SOLUTIONS.

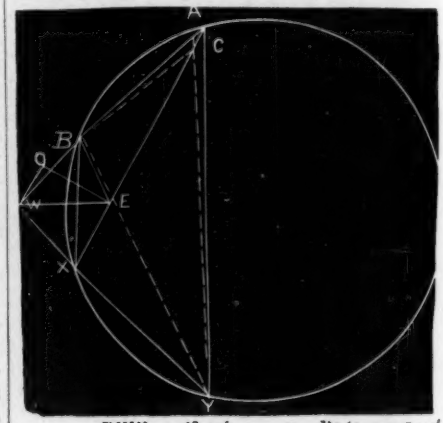
13, page 134. Inclination of plane, $i = 30°$

14, page 134. Side of garden, 7.53 rods.

M. T., JR.

MR. EDITOR:—I send you a solution, with diagram, worked out in full, of the problem in Trigonometrical Surveying given by B. McG. Liverpool, Eng., in ENGINEERIMG NEWS of Aug. 15, 1875.

[Owing to a mistake of the engraver the letters A and *y* have been transposed. Readers will please notice this in examining the solution. Ed.]



BWE = 48° 30′	BEC = 50° 04′
WEB = 70° 56′	WEB = 70° 56′
119° 26′	121° 00′
180° 00′	180° 00′
WBE = 60° 34′	WEx = 59° 00′
BWA = BWx 96° 10′	EWx = 46° 40′
BWE 48° 30′	WEx = 59° 00′
EWx = 47° 40′	106° 40′

WxE = 180° − 105° 40′ − 73° 20′

To find the angle BxE assume some distance for WE, say 500, then

sin. 60° 34′ : 500 :: sin. 48° 30′ : BE = 429.976
sin. 73° 20′ : 500 :: sin. 47° 40′ : Ex = 385.828
WEB = 70° 56′
WEx = 59° 00′ sum = 815.804
difference = 44.148
BEx = 129° 56′
(180° − 129° 56′) 2 = 25° 02′, ½ sum of angles.
815.804 : 33.148 :: tan. 25° 02′ : tan. 1° 26′ 51″
BxE = 1° 26′ 51″ 25° 02′ − 26° 28′ 51″

To find the angles of the given triangle

4060 : 5000 :: 1400 : 1724.139 ½ = 862.069
sum = 2892.069 difference = 1167.931
3200 : Radius :: 2892.069 : BAC = 25° 20′ 40″
1800 : Radius :: 1197.931 : BCA = 49° 32′ 42″
From which we find ABC = 105° 6′ 38″

$180° - 73° 20' = 106° 40' = yxA = yBA$

$180° - (106° 42' \quad 26° 28' 51") = 46° 51' 9" = ByA$

$46° 51' 9" . 3200 :: 106° 40' : Ay = 4201.738$

$\frac{1}{2}[180° - (26° 28' 51" - 25° 20' 40")] = 89° 25' 54"$

Sum of Ay and AC is 8261.738; difference is 141.738

$8261.738 : 141.738 :: \tan. 89° 25' 54" : \tan. 59° 57' 52"$

$89° 25' 54" - 59° 57' 52" = 29° 28' 2" = xyA = CyA$

$180° - (106° 40' \quad 29° 28' 2") = 43° 51' 58" = xAy$

$\sin. 106° 40' : 4201.738 :: \sin. 43° 51' 58" : xy = 3039.388$

$46° 51' 9" - 29° 28' 2" = 17° 23' 7" = Byx$, and

$xBy = 136° 8' 2"$

$\sin. 136° 8' 2" : 3039.388 :: \sin. 17° 23' 7" : Bx = 1310.525$

$\sin. 129° 56' : 1310.515 :: \sin. 26° 28' 51" : BE = 910.357$

$\sin. 48° 30' : 910.357 :: \sin. 60° 34' : WE \quad 1058.614$

$\sin. 88° 26' : 1058.614 :: \sin. 58° 44' : EO \quad 905.2$

$\sin. 88° 26' : 1058.614 :: \sin. 32° 50' : WO = 574.192$

Respectfully

N. L., West Point, Neb.

Notes and Memoranda.

Solid pistons turned ⅛ inch larger than the cylinders, and forced into their places by hydraulic power have been used with much success for high speed engines. They are found to remain tight for a considerable time.

The term "twist-screws" originated in a nickname applied to Romulus and Remus on account of the meanness of their dispositions. This fact has, from a confusion of ideas, led many to suppose that the Roman war-galleys were fitted with the above mode of propulsion.

The adhesion of locomotive driving wheels may be increased by covering the tyres with emery paper. The adhesion of the emery paper can be secured by gum.

The best wood for railway sleepers is bird's-eye maple. In fact, no sleepers made of this wood have yet been worn out.

The lead of a slide-valve is commonly made equal to the lap multiplied by one-tenth the travel. This proportion works well if it effects a good distribution of the steam.

Paddle engines were first applied to the coracles of the ancient Britons.

The durability of roofing slates may be much increased by creosoting them.

All the machinery erected in the great pyramid in the time of the Pharaohs, for stuffing mummies, was driven by water-power.

Concrete is being gradually substituted for iron as a material for steam boilers. One of its great advantages is that no safety valves are required, the concrete itself yielding when the pressure rises too high.

The first artesian well was sunk at Athens by Archimedes, to supply that city with water during a siege. The first Cornish pumping engine was also constructed by Archimedes.

Corkscrews may be made of steel wire.

Link motion was first applied to galley slaves by the ancient Greeks.

When James Watt invented his regulator for steam engines, he gave it the name "governor," out of respect to his aged parent.

A force of traction of 100 pounds is sufficient to draw a load of 26¼ tons at the rate of 2½ miles an hour on a canal. The same force would draw, however, only 1900 pounds at a speed of 13½ miles an hour. At the latter speed a given force could draw little, if any, more than on an ordinary turnpike road.

The reason why railway wheels always slip on the inner rail of a curve is because the flanges of the wheels press on the outer rail, and thus cause the most friction there.

A railway carriage, moving with a friction of six pounds per ton, would, if set in motion at the top of a straight plane falling 100 feet, and connecting at the bottom with a straight level line, run a little more than seven miles by its gravity alone.

If cold water be poured on roasted coffee finely ground, such as is generally used in boiling water, a considerable quantity of gas is generally evolved, about equal in volume to the amount of coffee used. If a bottle be half filled with this ground coffee, and cold water be then poured in until the cork is reached which is to prevent the escape of the gas, a violent explosion, sufficient to force the cork out of the bottle, or even to break the latter, will result.

It is a curious fact connected with deep mining, that from the hours of 12 at night to 3 in the morning the disturbing influence in the bowels of the earth obtains increased activity. At that time it is observed by miners that water falls from places where none is observable during the day. The volume in the wheel is perceptibly increased, the atmosphere is charged with gases which often prevent the lights from burning, and small particles of earth and rock are observed to fall from the top of the drives. Whether this phenomenon is to be attributed to the diurnal motion of the earth or other causes, it is worthy of the attention of the curious.

Castings of irregular forms and varying thickness are strained in cooling. Cast iron wheels with light rims and heavy naves often break of themselves soon after being taken from the mould, unless careful provision has been made for the unequal contraction of their inner and outer portions.

The "bull's eyes," or convex glasses, commonly used for lighting American ships, have been found in some cases to act as burning glasses, concentrating the rays of the sun to such an extent as to set cargoes on fire.

A long planing machine exposed on one side only to the rays of the sun, as in a workshop lighted only at the side, is thrown out of line by the unequal expansion of the slides.

Locomotive engine tyres two inches thick and of a diameter of 4½ feet, have been set with a shrinkage of 1⅛ inches in the inner circumference, and that without bursting or becoming loose.

In driving piles by Nasmyth's steam pile driver working at from sixty to seventy blows per minute, the heads of the piles sometimes burst into flame and burn fiercely.

It has been found that in very small capillary tubes — say of the 1-200th inch in diameter — water may be cooled as low as 5° before freezing. Under the same circumstances, water may be heated considerably above 212° before boiling.

Plumbing.

Equally important to a good system of heating is that of plumbing. Typhoid fever and diphtheria are invariably produced by the escape of sewer gas caused by defective plumbing. The pipes should be of sufficient size and the joints well caulked and secured, waste pipes branching from a main pipe should not extend in a horizontal direction more than five or six feet without having a separate air or ventilating pipe for the "trap," otherwise the trap is liable to be syphoned. Rain water pipes should not be depended upon to ventilate the soil pipes; during severe rain storms they become overcharged with water and closed against the escape of air, and the sudden increase of water in the sewer compresses the air and forces the gases through the traps into our buildings. Another cause of the escape of sewer gas into our buildings is the evaporation of the water in the traps when the houses are not occupied. It ought to be the duty of every person left in charge of an unoccupied building to let the water pass through the pipes of every wash basin, bath, sink, or water closet once a day of sufficient quantity to fill the traps.

The basins of water closets should not be of a conical form as commonly used, to which the excretions are apt to adhere and largely contribute to the impurity of the atmosphere of houses. The basins should be of a cylindrical form with perpendicular sides admitting of the excretions falling into the water at the bottom without coming into contact with the sides of the basin and which would thus be more readily kept clean.

To guard against defective plumbing work, the same ought to be tested before it is made use of. The test to consist in stopping the waste pipes at the bottom, and all other outlets, and, before the wash basins, sinks, water closets, etc., are connected, to fill all the pipes with water, this would produce sufficient pressure to test the quality of the waste and supply pipes and would prove whether the joints are perfect or not, and secure in this way an important agent in the ventilation of our buildings.

I suppose you are all familiar with the case mentioned by Dr. Reid, where about fifty members of one of the Royal Society Clubs at Edinburg dined in an apartment which he had constructed so that the product of the gas combustion and the vitiated air were removed by a ventilating pipe, and large quantities of a mild scented fresh atmosphere constantly passed into the room. The gentlemen present at the banquet were unaware of this arrangement, which had such an effect upon them that the caterer was struck with the enormous and increased amount of food and wines dispatched with the utmost ease and nonchalance by the same men whom he had so often seen languishing over a dinner in the same, but foul-aired room. Not one of them knew he had displayed an unusual appetite, and no one complained of headache or other indisposition at that dinner or afterward.—*Carl Pfeiffer.*

PROFESSOR BELL of the Canada Geological Commission favored us with a call a few days ago as he was passing through Chicago en route from the north shore of Lake Huron to his home in Montreal from which he has been absent since early spring. During the greater part of the season he was engaged in exploring new territory in the vicinity of Hudson's Bay, and for some months was cut off from all communication with his friends and civilization, but for the past month or so he had been collecting specimens of Canada geology and mineralogy on the north shore for the Centennial Exposition at Philadelphia.

During the past ten years Prof. Bell has been actively engaged every summer in the geological exploration of Canada, from Gaspe in the east to Manitoba in the west, and to Hudson's Bay in the north. To his extensive experience as an explorer of new regions he adds a thorough scientific knowledge acquired under the training of such well known scientists as Sir Wm. A. Logan, and Dr. Dawson, of Canada, and Dr. Lyon Playfair, of Great Britain; we are certain then that the readers of ENGINEERING NEWS will be pleased to know that he has agreed to favor our columns with an occasional contribution drawn from his personal experience as a topographical geologist.

Invention and Introduction of the Engineer's Transit.

[CONCLUDED.]

Mr. Manning but expresses the facts when he says, that in all *material* points but little change has taken place. The changes that have taken place, have been those called for by peculiar circumstances —modifications, which, while retaining the characteristics of the Transit, have approached more nearly to the peculiarities of the Theodolite. Transits in the after years became divided into the two distinct classes, FLAT CENTRE, as first introduced, and LONG CENTRE, with centres as previously used on Theodolite ; but it was not for many years that the long centre—for accurate work the best construction—became other than the exception. It now is the rule, and the flat centre the exception.

Engineers of the present day, unaware of the actual difference in these two styles, and unacquainted with the circumstances of early introduction of instrument, are apt to treat the flat centre with a disrespect it is far from deserving.

For the same strength, the flat centres are far the lightest. Said an experienced Engineer to us, within the few days past, "The first requisite of a Transit is lightness, and portability." Judged by these requisites, the flat centre is the instrument of to-day. But he spoke for his own peculiar branch—railways ; and while we are by no means ready to endorse this opinion, we have no hesitation in saying that the circumstances existing at the time of first use of Transit were such, that had the instrument been constructed with the long centre, its usefulness andgeneral introduction would have been very much retarded. The great peculiarity of the first made Transits was their ability to stand hard usage, and non-liability to get out of order under ordinary usage. The centre is a broad metal plate—thick, which it is impossible to bend, or injure in any manner, except by wear ; the plates were thick, not easily bent, and the spring vernier, in case of bending of plates, followed the motions and allowed the readings to be made sufficiently accurate to continue work. The rack and pinion had nothing that could break, while the tangents, as then constructed, were equally simple. If the standards, by a fall, were bent so that the telescope wonld not revolve in a vertical plane, the construction was such, that with the ax as a screw driver, the standards could be loosened, and a piece of paper inserted to correct them.

In fact, the opinion of the writer with means of observation, and the use of such an instrument, is : *That a flat centre Transit, rack and pinion, and spring vernier, cannot be made totally useless by any accident short of absolute breakage of parts.*

Not so, however, with the long centre. There, the least injury to centres or plates ends the usefulness of the instrument for its work, and it can stand comparatively ltittle rough usage without receiving this injury.

Of the good judgment of the first form of construction, the length of time that many of them have been in use—for some are still doing duty—is the best of evidence. Twenty-five years ago, as rodman, we followed and worked with a flat centre Transit, that to us then looked old enough to retire upon its laurels. So constant had been its use, that its corners, of hard hammered brass, the edges of its standards, and other parts, had then been rounded in carrying against clothing. Ten years afterwards we followed behind it, on the location of one of our main lines across the mountains, where, for a long time, it had been the sole available instrument ; and one year ago it was in the shop for repairs, the owner still believing that for railway work it had no superior. This instrument was light, weighing between fifteen and sixteen lbs. ; had seen at least 40 years' service, large part of the time in the hands of Assistants, and in the rough, wooded country. We doubt the possibility of a long centred instrument leading an equally long life.

While in charge of some Railway works, we kept in office, where there were several Assistants, both styles of instruments, and the Assistant's choice, in all cases, was for the flat centre.

It is not our intention to argue any superiority in the first form of Transit. It is not the equal, for accuracy and smoothness of motion, of the long centre. Its day of universal application has passed, and its field of usefulness narrowed ; but it yet *has* its field, and the Engineer will do well in making selections to give it fair consideration. Our desire is simply to do it justice, and to offer for it a slight defence to our younger Engineers, who having never seen or used it, can know but little of its faults or merits.

In the Transit's early days, no Express, on call, drove to the door, receipted for the boxes, and relieved all anxiety, no matter how many thousand miles away, nor what obscure point was the destination. Instead of this, they had in many cases to be consigned to the top of the stage, or to the Connestoga wagons, unless the destination was near the coast, when the sea became the best route. Thus we find the following extracts, looking at random into the books of shipments :

1833. Aug. 13. Sent, per ship Chester, to F. Beaumont, Natchez, care of Florchell & Co., New Orleans.

1833. Aug. 16. Sent, per brig Mohawk, to Boston, to W. G. Neil, for Boston and Providence R. R.

There is no difficulty in understanding why the call was for a Transit that nothing much short of entire annihilation would render necessary to send back, over its slow, long, and uncertain journey, for repairs.

The spread of internal improvements in this country had, at this time, fairly commenced, and with it the demand for the new instrument increased rapidly. So great was this increase, and so much did it outgrow the facilities of manufacture, that the inventor was compelled to send to England an order to have the greater part of a limited number of transits made. This was in 1835, and these were the first transits, or parts of transits, made in England. About three dozen were thus obtained, the more particular parts being made here. They proved far from remunerative ; some few were passable, others more troublesome, requiring alterations and repairs ; while a fatal fault to a needle instrument, iron in the metal, was found to exist in nearly a dozen.

Of the latter, most were broken up ; several remained in the establishment, in an unfinished condition, until recently, one of the last being taken to adorn the monument of a Civil Engineer, in Laurel Hill Cemetery, Philadelphia.

The earlier manufacture of the transit instrument was, for want of conveniences, attended with many difficulties. The art of Graduation had as yet made but little progress, and the introduction of the transit called for nearer approach to perfection. The first Graduating machines were extremely primitive, consisting simply of a circular plate of about 18 inches diameter, upon which degrees and half degrees were marked off, either by mechanical sub-divisions, or from a similar plate. The one in the establishment of W. J. Young, bears the name of ADAMS, Maker, LONDON, and consists of such a plate as we have described.

Such were the means of graduation in 1820. Mr. Young started, as soon as he commenced business, the construction of an engine of 24 inches diameter, worked by the endless screw and treadle ; and shortly after introduction of Transit commenced another of 26 inches diameter, for finer work, in which a new and important principle of construction for these engines was introduced. A few years afterwards, this same machine was rendered automatic, and is yet doing active duty, second to none outside of the establishment for accuracy. About the same time, Mr. Edmund Draper constructed a graduating engine, which, amongst those acquainted with it, has a high reputation for accuracy.

The completion of the large 48 inch Graduating Engine, by W. J. Young, which he intended to be the perfect engine of the world, completed a line of Graduating Engines, which, for completeness of range, is certainly not equalled here, perhaps not in any establishment in Europe.

As Transits advanced to perfection, these advances in graduation became necessary. That they were not made at once, but were the result of almost a life of thought,

work, and patience, and source of expense, is evident from the fact, that from the year 1821 to 1860, or but 10 years before his death, W. J. Young was almost constantly engaged upon the making or perfection of these engines.

Another serious difficulty arose from the want of opticians of ability. The first glasses used were imported principally from England. With the slow communication across ocean at that period, it was long before an order given could be received; and the purchase of all glasses to be found here, of proper size and focal length, furnished but a short supply. What was more troublesome, was the next supply differed in size and length from the last. When an inquiry for a larger instrument, or one of different construction, came, the question which determined the practicability of its manufacture, was the capability of making the telescope.

About 1849, an optician named Worth, commenced in New York the manufacture of glasses of telescopes for Engineer's Instruments, and they proving so much better than those otherwise attainable, the writer of this was sent to learn, under Worth's instructions, the optical art. Before long, arrangements were made, Mr. Young purchased the tools and mechinery, and it was removed to Philadelphia, along with the workmen, and connected with his establishment, with which it continued connected for many years, until, from increasing business, the tax on personal attention became too onerous; the tools and machinery were retained, and Mr. Worth placed in position to start for himself. From the optical department, as carried on during this period, came the majority of those now engaged in the manufacture of glasses for Engineering instruments. It gave the impetus which established the business permanently in this country. Fitz, of New York, and one or two others, had been quite successful in making the larger glasses for Astronomical Telescopes, but we believe had not turned their attention to the others.

The Transit instrument having thus been brought nearer perfection, in graduation and optical performance, received but few more changes in construction. The decimal graduation of vernier, suggested at an early day, by S. W. Mifflin, C. E., proved great advantage in the turning off deflection angles for curves, and was adopted by many, notably by the Engineers of Pensylvania R. R., all of whose instruments were graduated in that manner.

The *loose* vernier and arc, for vertical angles, applied by the writer about the year 1850, was an improvement over the much-liable-to-be-injured full circle.

The shifting Staff-head, patented by W. J. Young, in 1858, was another of those little improvements which increase the value of the instrument much.

The many varied uses to which, from progress of science in this country, the instrument has been called, has brought forth instruments of greater delicacy and different constructions, until, today, the finest Transit of the conscientious instrument maker is a splendid instrument, not surpassed in its performances by the production of any other country.

Of later minor improvements, some beneficial, some the exploded humbugs of bygone days, we are not now to speak. The profession have other, perhaps less partial means of discovering them. Our desire is simply to keep from oblivion, the dates and circumstances of introduction of the instrument which has played so important a part in the ever memorable forty-five years of American railroad construction, and which might, perhaps, be lost in the whirl which has been crowding the Railroad mind ever forward, leave it no time to look back to the earlier laborers.

The Mechanical Age.

The London Times, criticising Lord Derby's Manchester speech, says:

"However quick other countries may have been to develop the great mechanical discoveries of the century, it is to England that those discoveries are mainly due; and our riches have been derived as much from the genius and patient intelligence of men like Stephenson and Faraday, as from our stores of coal and iron. But until recently manufactures and machinery were regarded very much as outlying provinces of human energy, which might be left to take care of themselves. They brought wealth to the country and fortunes to individuals, but they were regarded as no more a matter of general concern than any other trade. They are now recognized as a kind of public care; and even in his capacity of Foreign Secretady, Lord Derby was invited at Manchester to treat them as of primary importance. Without going the length of Dr. Playfair the other day and treating the natural science as almost a substitute for all human culture, it is evident that, as a matter of fact, all culture is being brought to bear upon them, and that they are absorbing energy and attracting thought in every sphere of life. In view of this remarkable reaolution of thought, one is a little provoked by the very matter-of-fact reasons which are usually alleged in explanation of it, and Lord Derby, in the greater part of his Machester speech, was too true to his habitual caution in contenting himself with reiterating them. Labor, he says, is dear, and is becoming dearer; and it is consequently more and more necessary to invent labor saving machinery. Similarly, at Leed, the other day, even the apostles of science could find little more to tell us than that other nations are threatening to undersell us, and that we need all scientific appliances to hold our own. All this is, no doubt, true, but the reality is too vast and broad to be adequately represented by such statements of the case. To say that we must invent better machinery because labor is dear, however accurate, is nevertheless something of a reversal of the order of facts. What has made labor dear in England? Above all things the invention of machinery. A machine is only matter animated by intelligence; and it is not merely because the wants of men have grown more numerous, but because their intellects have grown more active, that they have at length reached a stage of their development at which they are concentrating their energies on asserting the dominion of intelligence over nature. It is this which is implied when we call the present a mechanical age."

Minutes of the November Meeting of the Civil Engineers' Club of the Northwest.

The 60th regular meeting of this Club was held at the Sherman House Club Rooms, on Tuesday, November 2d, 1875, beginning at 4:30 P. M.

The minutes of the September Meeting were read and approved.

The Secretary reported that no formal business was transacted at the October meeting.

Mr. W. S. McHarg, an associate member was proposed for full membership by Messrs. Potts and Morehouse.

Mr. Jas. R. Willett was elected a member of the Club.

The Secretary reported that he had settled satisfactorily to both parties, the matter concerning the lease of rooms for the last year.

Donations were reported by the Secretary:—

Address to the Graduating Class of the Stevens Institute, from R. H. Thurston, A. M., C. E.;

Report of a Reconnaissance of the Black Hills of Dakota, from Gen. A. A. Humphreys, Chief of Engineers, U. S. A.;

Proceedings of the Meeting of Roadmasters on A. & G. W. R. R., June 24th, 1875, and

July Statement of Expenses in Engineering Department, A. & G. W. R. R., from Chas. Latimer.

Mr. C. W. Irish proposed to donate to the Club a collection of minerals, geological specimens, &c.

The Secretary was directed to tender to Mr. Irish the thanks of the Club, and request him to retain the specimens until a suitable room should be obtained for the library and museum.

The paper for the evening "The Attractive Influence of Running Streams upon the Magnetic Needle," by Mr. C. W. Irish, was read by the Secretary, the writer not being present.

For lack of time the paper by Mr. I. C. Chesbrough, prepared for the October meeting, was deferred till December.

The Executive Committee were directed to report, at the next meeting, a list of books deemed suitable for purchase at the present time.

The Secretary was instructed to send monthly card notices to members, calling attention to each monthly meeting, as had been done prior to the publication of notices in ENGINEERING NEWS.

The meeting adjourned.

L. P. MOREHOUSE, Sec'y.

CIVIL ENGINEERS' CLUB OF THE NORTHWEST.

No. 55—The Attractive Influence of Running Streams of Water upon the Magnetic Needle.

A paper read before the Civil Engineers' Club of the Northwest, November 2, 1875, by C. W. IRISH, C. E.

In my early experience as a land surveyor, I observed at times, when engaged in tracing long tangent lines with the common compass, that the needle in certain localities along streams of water seemed fitful in its action. I always ran by backsights and foresights, and used the needle as a check upon my sighting. Working in this way, a practice of three or four years convinced me that the needle could not be depended upon to point in the same absolute direction for any space of time, however short. I then included the above mentioned action along streams on the part of the needle, under the general head of local attractions.

In 1855 I became the owner of an instrument known as the "Surveyor's Transit." It is so contrived that the telescope being fixed to the vernier plate, revolves horizontally with the verniers. By this instrument, horizontal angles can be read independently of the needle, and if desired, magnetic bearings can be taken to an accuracy of one minute of a degree. With this instrument I had the best in use for the purpose of watching the compass needle, so untruthful to my purpose and yet so true to nature.

My field of labor lay in the eastern, northern, and northwestern parts of the state of Iowa, thus giving me a great range of surface, and variety of streams to work over. I soon had a chance to test the instrument, and note the effect of running water upon the needle, while engaged in tracing a tangent some seven miles in length, lying in township 83 north, ranges 13 and 14 west of 5th principal meridian, and crossing a considerable stream known as Salt Creek. The bearing of the tangent at the end west of the creek, was north 41° 16′ east. At a point one and a half miles west of the creek, the bearing was north 41° 39′ east. At one half mile *east* of the creek, the bearing was north 40° 13′ east, while at the east end of the line the bearing was north 40° 16′ east. This last named point lay about four miles east of the stream. Here was a marked case. Guided by my experience in such matters, I repeated the observations at many and various points, and several times, during the succeeding three years, and never found a variation from the before stated results greater than 16′.

Afterwards, in running preliminary lines for the Chicago and Northwestern railway in Story County, Iowa, I found, in tracing a tangent twelve miles long from East Indian creek to Skunk River, that the north end of the needle was deflected to the eastward a little above two degrees in that distance, and that the north point began a movement towards the west after we had crossed the latter stream. In this case I had the opportunity to verify results several times. The notes have been mislaid, and I have to depend upon memoranda made at the time in a pocket diary, so that I cannot particularize as in the first case mentioned. I might go on quoting from my notes a large number of like cases, which I have preserved, to show the reasons that I have for my belief that running streams of water have magnetic polarity, and that from the running water always attracting the south pole of the needle, it is *north polarity*.

The most extensive experiment that I have made and elaborated, upon this species of "local attraction," was while engaged as assistant upon a preliminary survey for the Chicago and Northwestern railway in 1863, from Boonsboro, in Iowa, to Decatur, in Nebraska. The line passed through the towns in Iowa of Jefferson, Dennison and Onawa. The survey was under the direction of W. W. Walker and L. Burnett, Esq'rs. We ran from the west bank of the river Des Moines westward, and crossed North Coon river at an angle of about 60°, ran along Middle Coon river to its head, at that point crossing the Great Divide. Thence, we ran along East Boyer river to Dennison. We there left the West Boyer at about right angles, and crossing the divide between Boyer and Soldier rivers, ran along East Soldier to its junction with West Soldier, thence westerly to the Missouri at Decatur.

On this survey we passed over many smaller streams besides the main ones that I have named, and also crossed a great variety of surface. The line was traced by the means of a transit, using back and fore sights. The angles of deflection were read by the vernier to the nearest minute, as were the magnetic bearings of the tangent lines. For the purpose of having a check upon the work I took astronomical observations at intervals of about six miles along the line of survey, and repeated them when opportunity occurred, to insure accuracy. In these observations I used the Nautical Almanac circumpolar stars at their greatest elongations.

Thus did we carry on a complete set of observations upon the magnetic variation from the true meridian, across fully one-third the breadth of the State of Iowa. The results of these determinations, I present to the Club in the chart and profiles accompanying this paper.

The line of survey is represented upon the chart in red. It has each interval of ten miles marked upon it. The profile of the earth's surface is in black, and a corresponding scale of elevations above the water of the Des Moines river at the zero of the line is given at the left end. The magnetic profile is in red, and a scale of variations from the true meridian ranging from 9° 46′, the lowest observed variation, to 13° 32′, the highest variation observed on the survey. Each vertical space of the profile is taken to represent two miles, and each smallest horizontal space represents ten feet in elevation, or two minutes of a degree in the scale of variations. The scale at the right hand of the variation scale is placed with its zero at the lowest observed variation, and shows the entire change observed in degrees and minutes, The vertical spaces are numbered at each ten miles corresponding to the ten mile stations on the chart I have placed the letter *a* at the maximum points of variation, and the letter *b* at the minimum points.

It will be seen that the maxima and minima go in pairs, there being two of them at each point of change, and the two always of the same kind, as the case may be.

In conclusion: It will be seen by an inspection of the chart and profile alluded to, that the movement of the needle in the vicinity of a stream was as if the adjacent stream had *pulled* the needle's south end streamwards, both on the approach and recession of the needle. Now this movement on the part of the needle could only be induced by the stream possessing *north polarity*, and is such movement as the same needle undergoes when carried over a wire that is conducting a current of electricity.

I have carried on such experiments and observations in a great many cases, over lines from 80 to 200 miles in length, and find upon collecting the facts brought out that the results are in unison with those already described. Hence I conclude that running streams of water exert a perceptible effect upon the magnetic needle, and that the effect of the stream as thus evinced, and as far as I have had the opportunity to observe, is that of North Polarity.

If I have succeeded in describing and accounting for one of the peculiarities of the magnetic needle, and thus have helped to sift the subject of Local Attractions, then is my end attained.

TABLE OF MAXIMA AND MINIMA VARIATIONS.

Dist, mls.	E'n ft.	Var'n ° ′		Dist, mls.	E'n ft.	Var'n ° ′	
0	0	10 00	West bank Des	68¼	420	11 32	Valley of East
0½	280	9 46	Moines river.	72¼	380	11 12	Boyer.
1½	350	9 56		73¾	365	11 26	
6	250	9 48	Beaver creek.	76	350	10 56	Boyer river.
15½	230	10 45	Butrex creek.	82	680	11 6	Soldier and Boyer
17¼	240	10 38		84	550	11 20	(divide.
25½	300	10 40		88½	475	10 30	Valley of East
26	280	10 32	North Coon river.	94	415	11 36	Soldier.
28	280	10 38		98	350	11 28	
30	380	10 12		99½	335	12 8	Soldier river.
36	360	11 22	Middle and N.	108	600	11 0	Mo. and Soldier
39½	430	12 28	Coon divide.	112	430	10 30	(divide.
45½	430	11 38	Valley of Mid-	116	300	11 15	
46	450	11 56	dle Coon.	117	270	10 54	Little Sioux river.
48	440	10 56		128	250	13 32	
55½	560	11 20	Miss. and Mo. rivers	132	250	13 12	Missouri river.
67	430	11 20	(divide.				

On the Form, Weight Manufacture and Life of Rails.

A second Report, Presented May 5th, 1875, by ASHBEL WELCH, C. E. (Chairman.)

The members of the Committee on Rails desire, when they make their final report, to present some definite results, which a wide experience alone can establish. They therefore earnestly beg their professional brethren to state their experience on the subject, in response to the interrogatories issued by the Committee last year, or in any other way they may think best. In the meantime, a few points now settled will be presented, and a few questions raised for the consideration of the Society.

Forms of rails on the same principles as those recommended by the Committee have been adopted on three of the great railroad systems of the country—the Erie, Lehigh Valley and Pennsylvania. The Pennsylvania has also adopted the plan of a deeper head for main lines, on nearly the same base as a shallower head for branches; the base for main lines is 4½ inches.

The Committee considers it settled, that with the present weights on a wheel, a thickness of the middle of the stem of seven-sixteenths inch for steel, and one half inch for iron is sufficient; as fully proved in both cases by eight years experience with high speeds and heavy traffic on the main line between Philadelphia and New York; that an inclination of about one vertical to four horizontal for the under side of the head and top of the base is the best; that three-sixteenths inch is sufficiently thick for the edge of the base; that the top of the head should have a convexity given by a radius of about twelve inches; that the outer covering at the under side of the head should be as sharp as possible, also that, for a road much used, the fish-plate should be steel and its surfaces of contact at the top and bottom as great as possible.

In the former report, great breadth of head was recommended, because with a given weight the more it is distributed, the less the injury done by it. But it may be objected that as the wear on the side of the head in some cases is nearly as much as on the top, the diminished depth necessary to give increased width with the same amount of metal, counterbalances the advantage of the breadth. But the endurance of injury from the pressure of a given weight on the top is under some, perhaps not very unusual conditions, as the square of the surface compressed, while the endurance of shearing on the side is probably only directly on the surface. Besides, the wider the head the greater the aggregate amount of service.

With imperfectly welded iron, the angles made by the stem with the head and base should be somewhat filled in, and the joint fastening in that case made at the base.

[Transactions of the American Society of Civil Engineers, May, 1875.

The flange of the rail should not be cut, but the rail kept from crawling, by straps connecting the fish-plates with the ties, or by some other similar contrivance.

Rails should be symmetrical, and inclined to match the conical surface of the wheels, by dressing off the top of the tie, as is the practice in many parts of Europe. This can be done at a trifling cost by proper machinery. It prevents the bearing, while the rail is new, from coming only on a narrow strip of rail surface, which brings a great weight on a small area, both of rail and wheel, crushing the metal of the rail, and wearing a groove in the tread of the wheel. This groove in turn injures other rails. By making the top of the rail nearly a plane surface and giving it the proper inclination, a large area of contact can be obtained from the very first, and rail and wheel both preserved. This is much better than to round the head more than to about 12 inches radius.

A vicious practice prevails extensively among tracklayers of fully spiking down the rails before accurately lining and leveling up the track. If the track is crooked when it is spiked down, its tendency afterwards however carefully straightened, is to come back to the same crooks it had at first.

As the surfaces of contact between rail and fish-plate are liable to be worn by dirt, sand and cinders, lodging places for those substances should be avoided. This is one reason for bringing the sides and bottom of the head nearly to a sharp edge, so as to leave no opening between them to become such lodging places. Some of the Committee think the fish-plate should not be concave towards the stem, thus leaving a wide space between the two, which becomes a hopper to hold a supply of sand to be ground under the fish-plate. Such small matters, multiplied so often as they are, become important.

Nothing should be sacrificed to make the bottoms and tops of fish-plates alike. It would be advantageous to make the bottom somewhat wider than the top can be made, so as to have a broad bearing surface on the base of the rail, say an inch wide, so as to compensate for the greater wear by sand, &c., at the bottom of the plate.

The Chairman has always found so far as his observation went, and has long believed, that the joint on the tie makes the best track. His practice was to place these ties at the joint so close together as to allow for tamping.

With bases 4 inches wide, ties under them 7½ inches wide and 2 feet from centre to centre, the maximum weight on the wood being abont 400 pounds per square inch, good white oak will not, under ordinary circumstances, cut or wear out before it rots. But chestnut, the softer oak, or other soft woods, unless very elastic, should not have more than 250 or 300 pounds on a square inch if the road has a heavy traffic. With such ties, the rail should be 4¼ inches wide, and the ties more frequent and wide than otherwise.

It is objected to this very broad base that the increased metal adds nothing, or next to nothing, to the strength of the rail. But the important thing is bearing surface on the tie. A little more or less strength is of small account compared with the even bearing given by uninjured ties.

The plan of extending the bottom of the fish-plate beyond the outside of the base, so far as to have a considerable bearing on the tie, seems to be gaining ground. In favor of this plan it is said that it gives lateral as well as vertical stiffness to the joint; that by spiking through it, the rail is kept from crawling without notching the bars; and that it increases the bearing surface on the tie at the joint, just where it is wanted.

The two first of these objects would be gained by letting the projection extend beyond the base only to the depth of the spike notch. Against extending the projection so far beyond the base, as to bear much on the tie, it may be said that it increases the complexity, and therefore the difficulty and uncertainty of fitting; and that it creates cross strains and lateral movements, and consequent wear of the bearing surfaces.

The Committee is still unprepared to say much about the manufacture of rails. Some of the ablest rail makers have given the following rules as prominent among those necessary for making good iron rails.

"Select the stock best adapted to each part, the hardest metal for the head, the strongest for the base. Use only grey metal, not white. Put no old rails into the head or base; puddle thoroughly, or the metal will not weld thoroughly. Cut off and throw out all ends of puddle bars; make the top slab about 1¼ inches thick—thicker will not heat before the small bars burn—pile 8 inches square. The top slab should be four-rolled (thrice heated), the bottom thrice rolled and the stem twice rolled; no puddle bars in the rail. Each heating should be uniform and thorough without burning, or the welding will be imperfect."

Specifications are of little value if the puddling and heating are not faithfully done. An unwise saving of a dollar to the manufacturer, or a little unfaithfulness in the workmen, will probably reduce the value of the rail ten or twenty dollars. Ten or fifteen per cent. added to the ordinary work on rails would double their value. An expert rail-maker knows this very well, but he cannot put ten dollars extra work on a ton, in order that it may be worth sixty dollars more to the purchaser, who will not allow him any part of the ten out of the sixty he makes. The railroad agent who purchases may also know this, but he cannot follow his own judgment, for he knows his directors will say he paid ten dollars a ton more than the market

price. It is thus that the interests of stockholders are sacrificed.

Steel rails should contain from 0.3 to 0.55 per cent. of carbon, according to the character of the stock and the hardness that may be safe where the rail is used. On a good well-ballasted road-bed, not subject to harm with the frost, much higher steel would, of course, be proper than on a badly-ballasted clay foundation road-bed in a cold climate.

The main objection to very heavy heads and light frames below is, that the thin parts cool first and permanent strains are created. To prevent this, the base and stem may, while cooling, be immersed in sand or some other slow conducting substance, so as to cool no further than the head. It would also be well to clamp the rail while cooling, down to a level bed against a straight edge, which could be done by a very simple apparatus. Many good rails of all forms are ruined in straightening.

The holes through the stem should be drilled, not punched, and there should be no notch in the base. Before leaving the mill, the ends of all rails and also all fish-plates should be tried by a gauge, and if from unequal shrinkage or wear of rolls or imperfectly removed sand-burn or other cause, they are not accurate, they should be made so. Dressing or filing by track-layers will not make a sufficiently accurate fit.

The welding of iron rails may be very thoroughly tested by shearing off a short piece from the end. Each individual lamina will tend to curl up by itself and separate from the others, and will do so if the welding is not very perfect. As good welding is one of the essential qualities of a good iron rail this test is all important.

The Chairman of the Committee was so much surprised to find so little difference in the loss of metal in iron and steel rails, that since the former report was presented, he made further examinations of 58 steel rails rolled by John Brown & Co. and 7 iron rails rolled by the Bethlehem Iron Co. The steel had been laid from four to seven years, the iron from four to six years, all on the main line between New York and Philadelphia. To all appearance both steel and iron were as good as when first laid, except where the loss of metal was perceptible. The loss of metal per annum in the steel was from a few hundredths up to 0.59 pounds per yard, averaging 0.29 pounds, and in the iron, it varied from 0.15 to 0.6 pounds per yard, averaging 0.325 pounds. In the examinations mentioned in the former report the averages were: steel 0.3, iron 0.38 pounds per yard. This shows that if iron was perfectly welded and as hard in the middle of the head as on the top, and never loaded so as to crush or condense the metal (say not over 25 000 pounds per square inch) it would wear nearly as long as steel. The advantage steel has, is that it has no weld, is probably nearly as hard in the interior as on the surface of the metal, and that it will sustain without alteration or condensation a weight per square inch which would gradually condense and finally destroy the iron.

ASHBEL WELCH,
May 3d, 1875. Chairman.

The Influence of Forests on the Discharge of Watercourses and on the Moisture in the Air. By M. Fautrat.

Comptes-rendus de l'Academie des Sciences, Jan. 25, 1875, pp. 206, 207.

The discharge of a watercourse depends upon the rainfall over the area of its basin, and on the amount of evaporation. With the object of discovering what difference was caused in these respects by a country being open or wooded, some observations on rainfall and evaporation were made in the forest of Halatte, and at a spot at the same elevation 984 feet from the forest. The rainfall over the forest was 18 inches, or 1·33 inch more than the rainfall in the open country, between the 1st February and 25th December, 1874. If the rainfall over the forest is represented by 100, the rainfall in the open country is 92·5, and under the trees 62; but the loss from evaporation under the trees was found to be only one-third of that in the open ground, which latter is at least 70 per cent.; so that the ratio of the effective rainfall in the open country and in the forest is as 1 to 1·44; and if the protection from evaporation afforded to the ground by the covering of leaves is taken into account the ratio would be much higher. Forests consequently largely assist in supplying watercourses.

The hygrometrical observations show that over a forest the amount of watery vapour in the air is greater than in the open country, especially in May, and that forests thus afford moisture to the adjacent country.

On a Detector of Variation in the Pressure of Gas. By M. DuMoncel.

Bulletin de Society d'Encouragement, March, 1875.

The appa1atus consists of an alarum, which is put in action by an electric battery, at the instant the pressure of gas exceeds the desired amount. The liquid employed is a solution ot phostosulphate of mercury, maintained at the same level within two elements, each formed of two vessels placed one within the other, so as to produce a hydrostatic pressure. The larger is hermatically sealed, and the liquid is placed therein; the smaller is a tube of glass, open at either end, in which are placed a carbon and zinc plate; the former is immersed in the liquid, and the latter, with a knob at its extremity, is placed 0·04 to 0·08 inch above the liquid level; the smaller tube is hermetically fixed in the cover of the larger, in which are also two holes, through one of which passes a tube of caoutchouc in communication with the gas-meter, and through the other, one stem of a siphon, connecting the larger vessels.

A slight increase of pressure of gas raises the level of the liquid, causing the immersion of the zinc and the charging of the battery; the current causes the alarum to sound, until the pressure of gas has been reduced to its normal condition. The same instrument is also used to discover escapes of gas, and the Author refers to its value in regulating the consumption so as to produce a maximum effect with a minimum expense, an economy of 25 and 30 per cent. having been attained by it. It is added that the apparatus has been tried during four years with general satisfaction, and that the Societe d'Emulation of Rouen have already rewarded the inventor, M. Launay, whose long services as Controller of the Paris Gas Company have given him a vast knowledge of the subject.

The stockholders of the Pennsylvania Graphite Co., who have recently opened a plumbago mine at Byer's station on the Pickering Valley railroad, and erected works at that place to prepare it for market, were there a few days ago to witness a trial of the machinery. Everything worked to a charm, and the establishment will soon be put in full operation and will give employment to quite a number of hands. The black lead taken from their mines has been tested in the foundry, at Spring City, and we learn from an exchange that it was found to be of a superior quality.

The whaling season is nearly over and the vessels are beginning to be heard from. Five of the arctic fleet have already arrived at San Francisco, bringing over eight thousand barrels of oil. This is more than an average catch, and if the other vessels of the fleet, which are daily expected, bring as favorable quantities, the supply of this oil for the next years consumption will be considerably greater than usual, and correspondingly low prices may be expected.

Have self-reliance. Don't rely upon friends. Don't rely upon the name of your ancestors. Thousands have spent the prime of life in the vain hope of help from those whom they call friends, and thousands have starved because they had a rich father. Rely upon the good name which is made by your own exertions, and know that better than the best friend you can have is unquestionable determination, united with decision of character.

The export of American leather has risen from 800,000 sides two years ago to 1,800,000 sides this year.

The exports of petroleum from Philadelphia thus far this year show a falling off of nearly seven million gallons, as compared with the shipments of last year.

Alexander Wolcott is County Surveyor of Cook County.

Instruments and Machines.

THE BALANCE.

The balance is an instrument not less essential to the philosopher in his researches than in the business ot every day life :—"Mesurer et peser," says Biot, in his Traite de Physique ; "viola les deux grands secrets de la chimie et de la physique ; ce sont la les causes de tantes les decouvertes qu'elles ont faites dans ces derniers temps." To have an accurate knowledge of the instrument, it is necessary not only to be acquainted with the details of its construction, but also with the manner in which its action is affected by the atmosphere which surrounds it. In ordinary weighings these effects may be neglected ; but in delicate researches, and especially where the definition of legal standards is concerned, the most scrupulous attention must be paid to the temperature and pressure of the atmosphere, as well as to the effects of the changes of temperature on the weights and on the substance weighed. The true weight of a body is the force by which the earth's attraction draws it downwards, and is obtained by the balance, if the weighing be conducted in vacuo. If the air be admitted, it follows, from the principle of Archimedes, that the body weighed as well as the weight which counterpoises it, will be borne up with forces which are respectively equal to the weights of the volumes of air displaced. As these volumes are generally unequal, it is evident that the equilibrium will be disturbed : to restore it we must change the counterpoise for some other weight greater or less, as the case requires. This weight is the apparent weight of the body, and depends on the temperature of the air, the barometric pressure, and on the way in which the body and the weights are affected by change of temperature.

Let W be the true weight of the body, P its counterpoise in vacuo, and P in air ; let also w and p be the weights of the volumes of air displaced ; then it is evident that $W=P$, and $W-w=P-p$, from which—$P-P=w-p$.

We can calculate the weights w and p if we know the volumes to which they correspond, and also the temperature and pressure of the air.

1. By an Act of Parliament (5 Geo. IV. c 74) passed in 1824 the standard gallon was defined to be a measure capble of holding 10 lbs. avoirdupois of distilled water, weighed in air with brass weights, at the temperatnre of 62° F., the barometer standing at 30 inches; let it be required to find its true weight.

The contents of such a vessel sre 277.274 cub. in. The weight w of this volume of air at 62° F., and barometer 30, is 85.652 grains. If the specific gravity of the brass whights be 7.824, the weight p is evidently the quotient of w divided by this number, or 10.947 grs. The true weight, therefore, exceeds the apparent by 74.705 grains. True weight—70064.705 grs.

2. The legal standard of the metric system is the kilogram, and is defined to be the weight in vacuo of a liter of distilled water at 4° C ; let it be required to find the apparent weight of a liter of water weighed in air with platinum weights ot 60° F., and pressure 30 inches.

According to Regnault, the weight of a liter of air at 32° F. and 760mm pressure is 1.293187 grams, the weight, therefore, at 60° F.—15°.55 C. and pressure 30 inches—762mm is 1,2269 grams. The volume of the platinum weights at 32° F. is one cubic decimeter, divided by the sp. gr. of platinum, 22.06; therefore p —0.0556 grams, and consequetly to obtain the apparent weight we must subtract 1.1713 from the true weight. Appareut weight—998.827 grams.

THE MOUNTAIN BAROMETER.

The weight of the barometric column is equal to that of the atmospheric column, which stands on an equal base. It is evident, therefore, that as we ascend in the atmosphere the height of the mercurial column must become less and less as the superincumbent weight of air diminishes. To confirm this by direct experiment, Pascal, in the year 1648 A. D., requested a friend to ascend the Puy de Dome, a mountain of Auvergne about 5,000 feet high, with a barometer, in order to compare its height when at the top and at the bottom of the mountain. The result of the experiment showed that the mercurial column was between three and four inches lower at the top of the mountain than at its base. This completely fulfilled Pascal's conjectures, and laid the foundation of a correct knowledge of the physical properties of the atmosphere. At the sea level the height of the barometer varies from 28 to 31 inches : the lowest ever observed, about 13½ inches, was seen by Gay-Lussac in a balloon ascent, in which he reached an altitude of 23,000 feet above the sea.

THE CAMEL.

This apparatus is used for lifting a ship over the bar of a river without unlading : it consists of a large wooden case, made water-tight ; the mode of using it is to slip a pair of cables under the ship's keel, one near her stern, the other under her bows ; the four extremities of these cables are attached to camels filled with water, and sunk close by the ship's side to a convenient depth ; the water which they contain is then pumped out ; this causes them to rise to the surface, earrying the vessel upwards with them ; when the draught of water is sufficiently diminished, the ship is towed across the bar into deep water. Suppose the interior dimensions of one of these chests to be 20 feet long, 6 feet wide, and 8 feet deep ; that its thickness is 2 inches ; and that it is constructed of wood whose sp. gr. is 0.6 ; it may be easily shown that its weight is very nearly two tons, and that the amount of water it displaces, when wholly immersed, is 27 tons ; its acensional force is therefore equal to 25 tons. Four such camels attached to a vessel in the way described lift it out of the water with a force equal to 100 tons.

THE BALLOON.

The first balloon ascent was made in the neighborhood of Paris in the year 1783, A. D., by Pilatre de Rozier and the Marquis d'Arlandes. The balloon they used was that invented by Montgolfier : it consisted of a large spherical envelope, with a circular gallery attached to its lower extremity, in which the aeronauts were carried ; inside the balloon, and a little above the gallery, was a grating, on which straw and paper were burned ; the combustion of these substances expanded the air contained in the balloon, and consequently expelled some of it. This rendered the weight of the balloon lighter than an equal volume of the air at the external pressure and temperature, the consequence of which was, that the balloon ascended in the air with a force equal to the difference of these two weights.

In consequence of the danger attending these Fire-balloons, or Montgolfiers, as they are called, their use was soon abandoned,—not indeed until some lamentable accidents had occurred—and in their place was substituted the Gas-balloon. Instead of filling the interior of the balloon with heated air, we introduce a gas lighter than air ; as hydrogen is the lightest substance at present known, it seems peculiarly eligible. We estimate the ascensional force of a balloon filled with hydrogen as follows :—A cubic fathom of air at the standard temperature and pressure weighs 16. 535 lbs. ; and a cubic fathom of hydrogen weighs 1.141 lbs. If this be subtracted from 16.535 lbs., we obtain 15.394 lbs., or in round numbers, 15 lbs. for the ascensional force of a cubic fathom of hydrogen. To obtain, therefore, the ascensional force of a hydrogen balloon, multiply its contents in cubic fathoms by 15, and from the product subtract the number of lbs. weight in the car and balloon. The first ascent in a balloon of this description was made by MM. Charles and Robert from the Champ de Mars, on the 26th August, 1783, A. D. ; their balloon was 27 feet in diameter, and contained 50 cubic fathoms ; this volume of hydrogen was able to lift, according to the above rule, 750 lbs. ; and as the weight of the car and silk of which the balloon was made was much less than this, a considerable ascensional force remained. In consequence of the difficulty and expence of procuring a sufficient quantity of hydrogen gas, modern aeronauts have preferred to increase the size of their balloons, and use coal gas, which has a specific gravity of about 0.500 ; this substance is easily procured in any quantity in large towns, in the neighborhood of which balloon ascents are generally made. To find the ascensional force in this case, we multiply each cubic fathom by 8¼ lbs.

The Chicago and Northwestern railway car shops in the suburbs of Chicago are now so nearly completed that they will be in running order within thirty days. A new boiler shop for the locomotive department has just been finished. This department will employ 400 men. The old car shops in Chicago will be abandoned. The company is now building two baggage cars 40 feet long, with 4-wheel trucks, and one 50 feet long, with 6-wheel trucks ; also a 46-foot passenger coach.

LIVERPOOL WATER SUPPLY.

[CONCLUDED.]

The advocates for carelessness in the distribution of water may find numerous examples of the disastrous influence of too strong a feeling of security in abundant supplies. That such supplies are desirable cannot be doubted, but it is equally true that they should be conserved with the greatest care for the reduction of rates, the cheapening of manufactures, the systematic and intermittent purifying of sewers and streets, and last, but not least, to provide ever-flowing fountains among the dwellings of the poor.

Before explaining the method lately adopted in Liverpool for the prevention of waste of water, and the results which have attended those measures, the conditions of supply and demand during the last few years will be briefly stated.

In the year 1858, water was for the first time laid on constantly to nearly the whole district, an area of 60 square miles, which the Corporation were bound to supply. The quantity available, under the most favorable conditions, was apparently ample, and it might reasonably have been expected to meet the demands of the increasing population for many years to come; but within seven years the people were again subjected to the intolerable annoyance of intermittent service. In August 1865 it was found necessary to reduce the service througout the borough to twelve hours, in September of the same year to seven, and ultimately to three hours a day; yet, notwithstanding this, the mean consumption for the year was 25.01 gallons per head per day, not including trade supplies.

Various steps were then taken to obtain further supplies; and before 1870 the whole available yield was increased by about one-fifth, by sinking new wells and boring in the New Red Sandstone near Liverpool, and by the purchase of water at Rivington, hitherto given as compensation. Notwithstanding this, however, the average number of hour's service was gradually and of necessity decreased, while the consumption per head did not diminish; and in 1873 it was for the first time found necessary to place the Out Townships, containing 109,749 persons, under intermittent service.

A new supply had been talked about, but many years must elapse before the necessary works could be carried out, while any year might bring with it a dearth of water. Powers for such a supply could only be obtained on condition that constant service would be given; and it had been ascertained by experiments that the average constant service would not be less than 33.5 gallons per head per day, exclusive of trade supplies by meter. Even if the Liverpool people had believed that they were justified in asking for it, with the examples of Norwich, Manchester, and many other towns before them, the fact that so large a proportion of their present supply during twenty-four hours was utterly and harmfully wasted would have constituted a powerful argument in the hands of opposing counsel. The further prevention of waste was therefore regarded as a necessity; while the restoration of constant service, which, it appeared to the Author, ought to be given with the existing supply, was looked upon as a possible concomitant.

The past measures for the prevention of waste in Liverpool to the year 1873 has been ordinary house-to-house inspection. In 1872 the Author made a series of experiments, with a view to devise means for discovering the locality of a larger portion of the waste than the house-to-house inspectors were enabled to trace. These experiments were conducted with the ordinary piston meter, and in the following manner.

A district was divided into a number of blocks of houses, each block being placed in charge of a trustworthy man at the same hour, while the occupants were requested not to allow any water to be drawn until they received further notice. As an additional precaution, these men closed and fastened every tap, ball-cock, and other fitttng, in order to prevent all use, and so far as possible all superficial waste. The meter resumed its steady rate of movement, and the quantity found to be still passing averaged 7.9 gallons per head per day; while in one of the four districts under examination it was as high as 14.5 gallons. Outside each house, under the footways, the service pipes had been provided with stopcocks, and while the fittings were still tied it was found that each individual waste could in nearly every instance be heard, when the street was quiet, by applying the turning key to the stopcocks and placing the ear upon it.

The application of this system of detecting waste has been long known, but it was found impracticable to carry it out successfully during the day, except as an experiment, because it was necessary in each case to tie up and watch the fittings, and because the noise of traffic rendering the sounding operations extremely difficult.

During the night these obstacles did not exist. So long as the Engineer or any of his chief assistants personally superintended the nocturnal work, the results were successful; and by counting the strokes per minute of the meter from time to time it was easy to ascertain the waste, which had been checked by closing those stopcocks through which water was discovered to be passing. The premises connected with such stopcocks being reported on the following morning, became the subjects of examination by the day inspector.

The advantages of the system were manifest, as the labor of discovering waste was reduced, the certainty of discovery increased, and the annoyance to conscientious householders by an ordinary house-to-house inspection removed.

By these means the consumption of water for the whole set of experimental districts, containing 31,080 persons, which under nine hours' service had been 19.5 gallons, and under constant service 33.5 gallons per head per day, was reduced under constant service to 13.3 gallons, and subsequently to about 12 gallons; while in one district of 2,134 persons it was brought down to 6,6 gallons, without altering a single fittting which had not been found to be actually wasting water.

A little consideration showed, that, in order to obtain such results over the whole district of supply, including a population of 630,000, in a sufficiently short time to ward off the expected dearth of water and to restore constant service, several districts mnst be inspected every night. The difficulty of efficient supervision would have been very great, and it would have been impossible to ascertain how far the closing of the stopcocks commanding wasteful property had been faithfully performed, as no record was preserved of the change in the rate of movement of the piston meter, except that returned by the inspectors themselves. The cost, too, of reliable piston meters and of the necessary chambers was at least £112 for each district of about 2,500 persons, while the expense of maintenance was considerable.

It was under these circumstances that the Author devised an automatic check upon the motions, at once of the night inspectors and of the water, the cost of which is comparatively small. The instrument known as the Waste-water Meter records the time and rate of flow through the main, after the manner in which an indicator diagram records space and pressure. The diagram drawn by the instrument distinguishes water wasted from water used. It registers not only the change of velocity, induced by the closing of any stopcock during the night, but the time at which the men commenced work, and the time at which they ceased work. Such an instrument would, if applied to all service mains, give the means, first, of ascertaining at any time the most wasteful districts, and thus enable the superintendent to concentrate the energy of his men on the streets which most require attention, and subsequently of insuring the efficiency of the examinations during which the waste is limited to a few premises only.

The apparatus has been described elsewhere, and was recently reported upon to the Liverpool Corporation by Mr. F. J. Bramwell, M. Inst. C. E. It is unnecessary to do more than to explain, that in the instruments now made the diagram is carried on a revolving drum 6 inches diameter, and is divided by horizontal lines into sixty-two spaces, each of which represents 100 gallons per hour; so that the maximum rate of flow capable of being registered is 6,200 gallons per hour. By vertical lines the diagram is divided into twenty-four equal spaces, each of which passes the pencil in one hour. In the actual sheets the horizontal lines are not quite equidistant.

In applying the Waste-water Meter the city was divided into Waste Water Districts, the largest of which contains 4,271 persons; the average maximum rate of flow being about 3,500 gallons an hour, and the mean rate per head per day 13.5 gallons. The smallest meter district contains 870 persons, the average rate of flow being 4000 gallons an hour, and the mean rate per day per head 51 gallons.

The total number of meter districts on the 10th of April 1875, was 120, and the population under control 306, 912 so that the average population of the districts was 2, 557.

The cost per thousand persons in a town in which stopcocks are already laid would average for the meter and fixing £14 7s. If, however, as in the case of Liverpool, the greater proportion of the stopcocks have to be charged to the system, the cost, including the meter, would be about £39 7s. per thousand persons.

A district having been selected, a sketch is prepared showing the place the meter is to occupy. A single length of pipe is removed from the outlet side of the service valve, and connecting pipes are laid to beneath the nearest point of the footway and convey the water through the meter. The cast-iron meter cover is placed in the footway next to the kerb.

After a meter has been fixed, readings are taken to ascertain the consumption of water in the district under the ordinary intermittent supply. The district is next placed under constant service, and the consumption ascertained under that system, before any measures for the prevention of waste are commenced. In twenty-four hours a complete diagram is drawn. If the meter is left for seven days, seven complete diagrams will be superimposed upon each other. In such cases the night consumptions are distinct; but the day consumptions, owing to the greater fluctuations, are generally more or less confused. It is therefore usual at first, when particularly accurate information is required to remove the diagrams every second or third day.

The next step is to attach stopcocks to the lead service pipes of all premises, or blocks of premises which are not already capable of being controlled from the exterior. The details of the stopcock and its cover are most important; and in Liverpool the existing plugcocks and defective covers have created much difficulty. All new stoptaps are on the screwdown principle, and the loose valve is so arranged that it cannot fall out when the stuffing-box is removed, The surface cover is fixed into the upper side of the flag with Portland cement. The hinged lid is round, and large enough for a man to pass his arm down. Though all new pipes are laid 2 feet 6 inches deep, the stopcocks are fixed just within arm's length, in order that a washer may be replaced without opening the ground.

The number of persons included in the area under tests is now to be determined, In residential property a fair estimate can sometimes be made on the basis of the Government census, or by analogy from actual numbering by the water inspectors in another and similar class of property. Where, however, as frequently happens, a satisfactory estimate cannot be made, inspectors are sent to every building to inquire the number of occupants, and in these cases they also examine the fittings, and furnish a return in a form supplied by the Warer Board.

For some time past twelve meters, controlling about 25,300 persous, have been fixed each month; and it is found that with one chief inspector, twelve ordinary inspectors, six laborers, one Waste-water Meter inspector whose exertions are confined to the meter districts, and two inspectors to attend to special reports in other districts, it is easy to restore constant service to 5,000 persons per week, to sustain it in the old meter districts, and to maintain the average consumption over the whole area supplied at a constantly diminishing rate.

The recent progress of the system may be shown by comparing the circumstances of 1873, of 1874, and of 1875.

In March 1874 about 170,996 persons, and in March 1875, 373,500 persons in the borough were receiving constant supply.

During 1873 the maximum number of hours service to the intermittent districts in the borough was 10½; the minimum, 7½; and the average 10. Since then the average has been maintained at 10½ hours throughout the year.

In 1873 the Out Township supply to 91,835 persons was reduced for an average of fourteen weeks to 12 hours per day. Since then constant service has been maintained in the Out Townships.

At the beginning of 1874 the total population supplied was about 621,000. At the beginning of 1875 it had increased to about 632,000.

During 1873 the water taken for all purposes, excepting manufacturers' supplies measured by meter, was 5,437 million gallons, or 24.42 gallons per head per day. During 1874 the corresponding quantity was 5,478 million gallons. or 23.8 gallons per head per day.

In March 1874 the rate of supply was about 24.21 gallons per head per day.

In March 1875 it was about 22.26 gallons per head per day.

It is to be regretted that comparatively few persons apprehend the importance of the work in progress, with anything like the eagerness which would be evinced if the reduction in the rate of waste, instead of being chiefly manifested by the restoration of constant service, were shown in the actual figures of water saved, as would be the case if Liverpool had in 1872 been receiving constant supply.

Fortunately the meters give the means of determining the actual saving in water, on the assumption that the town was receiving constant service from the beginning.

In nearly every waste-water district, the quantity of water taken, under the constant system, has been determined before disturbing the initial rate of consumption.

The number of persons to whose service the Waste-water Meter system has been applied in Liverpool, to the 10th of April, 1875, is 234,000, but many of the districts have as yet received little attention at the hands of the night inspectors. Taking that moiety of the districts to which attention has been chiefly given, the supply to 117,425 persons, which under constant service averaged 32.12 gallons, has been reduced to 15.97 gallons per head per day. If the whole population under treatment be considered, the rate per head per day to 234,000 persons, is found to have diminished from 28.89 to 16.47, which is eduivalent to a total saving of 1,060,792,200 gallons per annum.

It is known, by experiments in a few isolated cases that the waste in these districts may be further reduced; but the Author systematically avoids occupying the inspectors' time in those portions of the town to which constant service has been restored, except so far as it is necessary to do so, in order to keep down the total consumption, as district by district the change is made.

In comparing the rate of consumption per head per day in Liverpool, with that of other towns, the following considerations must not be lost sight of:—

Unlike most towns in which constant service has been given and maintained at a low rate of consumption, the inmates of four-fifths of the houses are provided with water-closets.

The term "domestic consumption" has been somewhat improperly applied and has a much wider signification than in most other towns, as it includes all supplies for sanitary purposes, and a large proportion for business purposes. In other towns it is usual to confine the term to the use of water in private dwellings only; and this difference would be equivalent, in most cases, to several gallons per head per day.

The system described has been tried in every class of property; and in some districts containing the best houses the saving of water has been quite as great as in any others. It is certain, moreover, that the most wasteful districts have not yet been reached, and there is every prospect of a rich harvest during the present year.

Dr. Linderman, Director of the Mint, estimates the gold and silver production of the country next year at one hundred millions.

Common Error in ascertaining Locomotive Adhesion available for the Traction of Trains.

Annales du Genie Civil, March, 1874.

The Author states that ordinarily, after having determined the total tractive force which can be produced by the adhesion of any particular locomotive on the rails, engineers deduct therefrom a certain proportion, as being required for the locomotive itself, and treat the residue only as available for overcoming the resistance of the tender and other parts of the train. The Author is of opinion that engineers make this deduction on the basis that the friction between the wheels and the rails has to overcome the resistance of all the moving parts of the engine, and he enters into elaborate arguments with illustrations to show that it is the steam which has to overcome this resistance, and that the adhesion of the engine is not called upon to play any part in the matter.

Further, he directs attention to the fact that by coupling a second pair of wheels in a locomotive, so as to turn them into drivers, not only is the adhesion available for traction increased by the effect of the weight upon the other pair of driving wheels thus brought into play, but that the adhesion formerly employed to overcome the journal friction of these wheels is no longer necessary. By assuming a proportion between the diameter of the wheel and that of the journal of 7 to 1, and a load of 10 tons upon the pair of wheels, with a friction on the journals of 1–20th, he proves that 160 lbs. out of the whole adhesion, required to overcome the friction of the journals, are now set at liberty for the purpose of assisting in drawing the train; and he attributes to this fact the explanation of a matter observed by M. Flachat, viz., that the adhesion of two pairs of coupled wheels was a greater percentage of the insistent weight than that afforded by the adhesion when one pair of driving wheels only was employed. M. Flachat explained this discrepancy by assuming that the wheels were not truly of the same diameter, and that thus there was a slight grinding action which increased the adhesion. The Author, however, believes that he has found the solution in dispensing with the journal friction of the one pair of wheels.

The Proposed Hudson River Suspension Bridge.

The company organized some time ago under the name of the Hudson River Suspension Bridge and New England Railway Company, are again bringing to public notice the plan, long ago proposed, of spanning the Hudson River with a railway bridge. A board of engineers, appointed to consider and report upon the location, decided that the best point at which to span the river would be between Fort Clinton and Anthony's Nose. This point was chosen, and surveys have since been made for the various railroad connections which are proposed or decided upon. The plan of the bridge has also been perfected, and everything seems to be in readiness to proceed, so far as engineering preliminaries are concerned.

Of the financial prospects of the company we have no trustworthy information. Several times the announcement has been made that capital had been subscribed to an amount sufficient to carry the work forward to a point from which it could be completed, in the absence of other subscriptions, with capital borrowed on the strength of the company's legitimate commercial credit. How this may be we cannot say, but there certainly should be no serious difficulty in raising money enough to build a work so necessary, and considering the comparatively small investment required, with as good chance of profit as such a bridge offers. A bridge across the Hudson, as near New York as possible, has become a commercial necessity. The great volume of exchanges between the New England States on the one hand, and the Middle, Southern and Western States on the other, must now be subjected to costly and inconvenient trans-shipment at the Hudson River, except that moved by the lines which can avail themselves of the bridge at Albany. The coal traffic between Pennsylvania and New England would alone justify the construction of a bridge across the Hudson at the lowest practicable point, and when to this is added the passenger and miscellaneous freight traffic which would naturally pass over a bridge thus situated, there would seem to be no doubt but that the revenues would be sufficient to pay interest on the cost of a bridge economically built by competent engineers.—*Iron Age.*

We have received a specimen number of the "Nursery, a monthly magazine for youngest readers," published at 36 Bromfield street, Boston, by John L. Shorey, and, judging from the continued interest in its handsome pages manifested by our own youngsters, we cannot but feel assured that it will give equal satisfaction wherever it may go. It is beautifully illustrated and its subscription price is $1.60 in advance.

The old "John Bull," the first locomotive ever run on the Camden and Amboy Road, which has been laid up in the Bordentown shops for many years, is being put in running order again, and will be sent to the Centennial next year. It was built by Robert Stephenson over 40 years ago, has 12 by 20 inch cylinders, one pair 4½ foot drivers, and weighs about 12 tons.

Correspondence on subjects pertaining to this paper is earnestly solicited.